# MODIS ANNUAL REPORT
# - December 15, 2000 -


## UNIVERSITY OF MIAMI
## RSMAS/MPO

## DR. ROBERT H. EVANS


## NAS5-31362

**CONTENTS**



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## A. PERSONNEL

Personnel supported for the year 2000 include:

B. Evans (Jan, Feb, Mar, Apr, May, Jun)
V. Halliwell (Jan, Feb, Mar, Apr, May, Jun)

K. Kilpatrick (Jan, Feb, Mar, Apr, May, Jun)
J. Jacob (Apr, May, Jun)
A. Kumar (Jan, Feb, Mar, Apr, May, Jun)
J. Splain (Jan, Feb, Mar, Apr, May, Jun)
S. Walsh (Jan, Feb, Mar, Apr, May, Jun)
R. Kolaczynski (Jan, Feb, Mar, Apr, May, Jun)
D. Wilson-Diaz (Jan, Feb, Mar, Apr, May, Jun)
J. Brown (Jan, Feb, Mar, Apr, May, Jun)
E. Kearns (Mar, Apr, May, Jun)
A. Li (Jan, Feb, Mar, Apr, May, Jun)

## B. OVERVIEW OF RECENT PROGRESS

### B.1 Processing and Algorithm Development

**A-side sensor characterization:**

Before the MODIS ocean data can be fully utilized by the scientific community, the performance of both the complex sensor system and the algorithms must be evaluated. The sensor characterization examines several issues, including detector-to-detector discrepancies within wavebands, variations in the mirror response as a function of angle of incidence, differences in characteristics between mirror sides, effects of spatial and spectral cross-talk, and problems associated with polarization and sun glint.

Early at-launch images (Fig.1) demonstrated severe striping and discontinuities in both the along and cross scan direction. Sensor characterization and use of revised calibration tables produces a dramatically improved image (Fig. 2). Corrected images are remarkably full of detail, even in oligotrophic regions

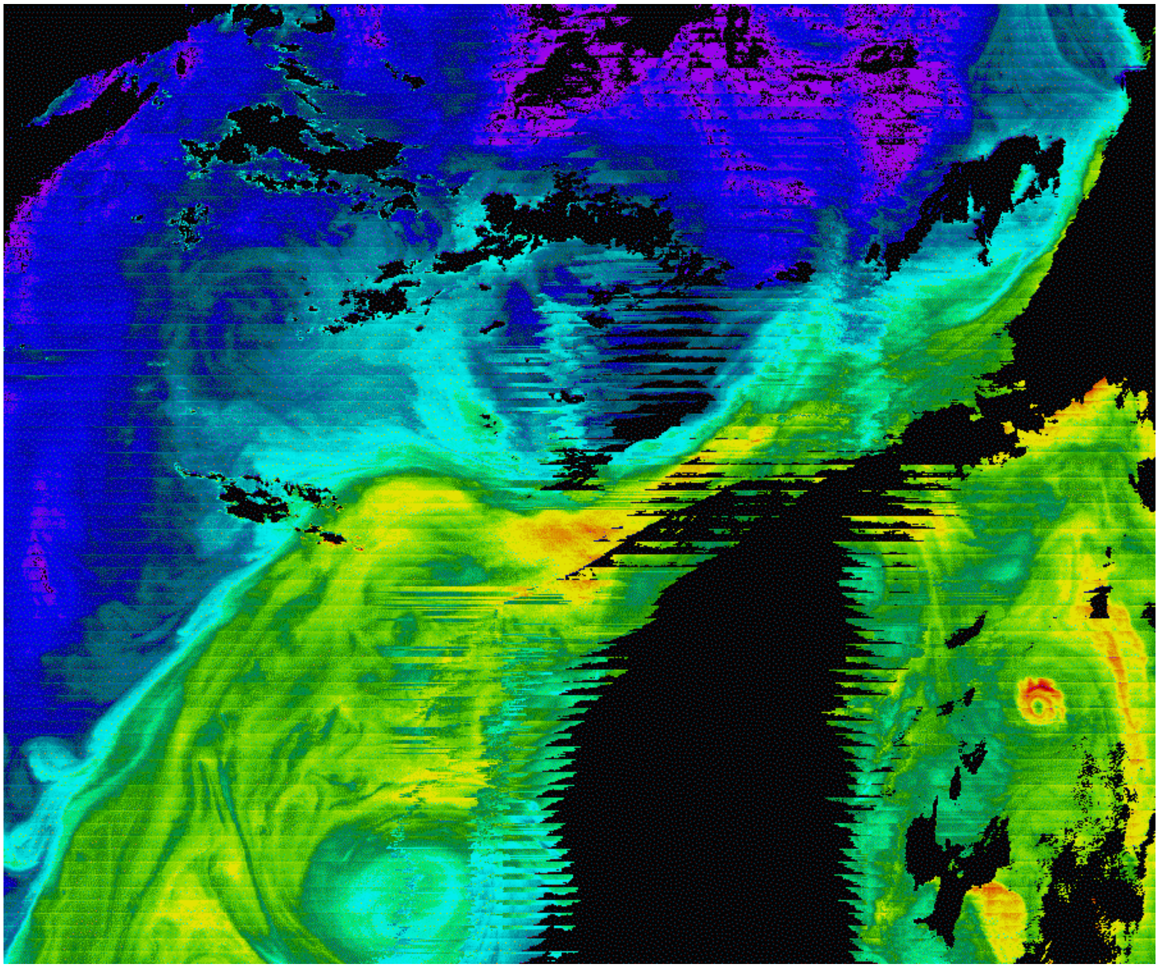


**Figure 1. Uncorrected image Level 2 1-km nLw_443 unmodified.**
**East Coast U.S.**
**May 8th, 2000 (L1b v2.4.3, 129:1545).**
**Note non-physical structure extending from black sun glint region**

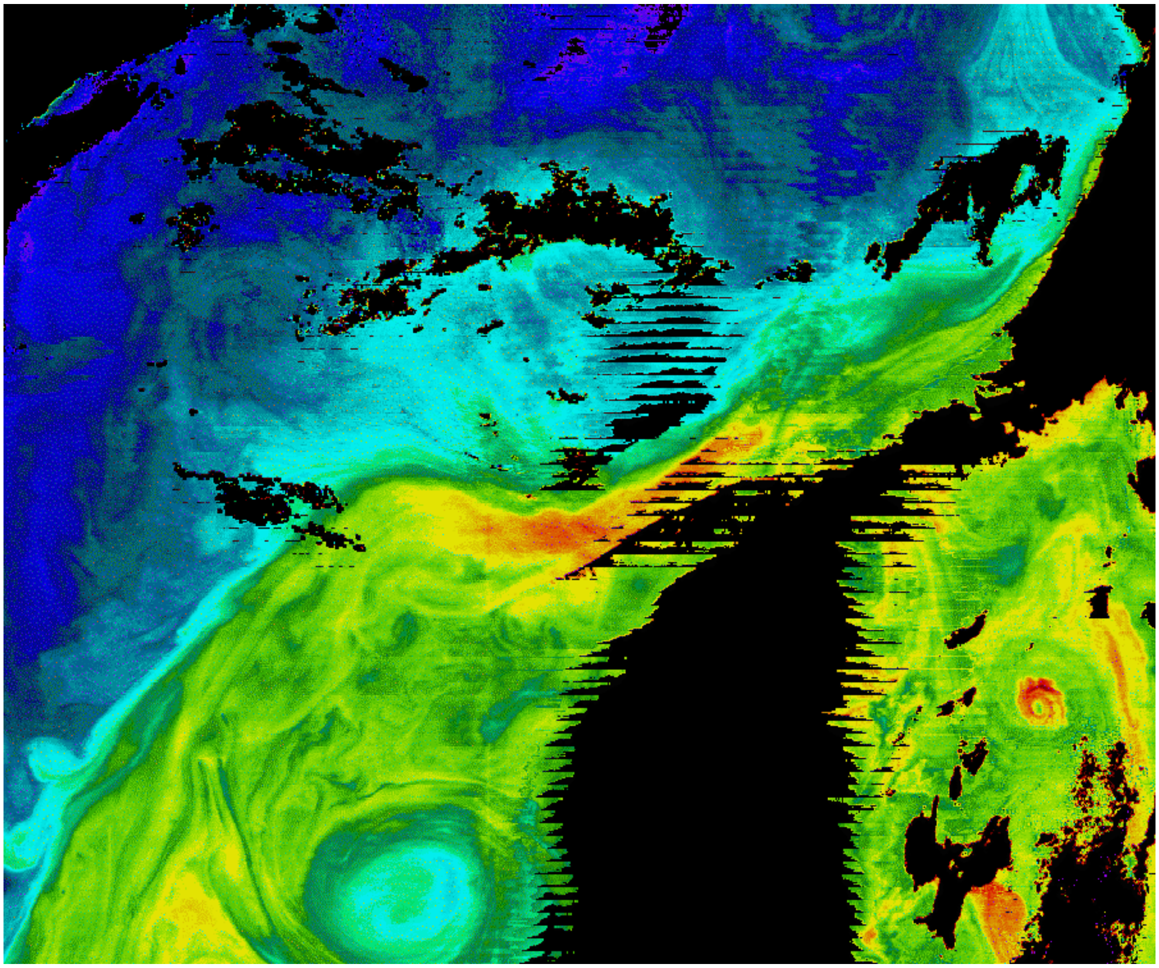


**Figure 2. Corrected image Level 2 1-km nLw_443 corrected East Coast U.S.**
**Jagged appearance of glint edge is due to variations in scattering from top to bottom of detector array.**

The large portion of the gross striping pattern seen in Figure 1 is the result of an unbalanced response between the 10 detectors within a scan line. Multiple detectors must be balanced at the level of the precision of the detectors (i.e. 12 bit system). Detectors must therefore be balanced to better than 0.1% or severe striping will be present.

The best solution to balancing the detectors was to approach the problem from the viewpoint of water leaving radiance (Lw) through the atmospheric correction physics, not total radiance (Lt). With multiple detectors there is real geophysical variability in Lt within a scan due to varying satellite azimuth angle across the detectors. Other factors such as the response-versus-scan angle (RVS), polarization, sun glint (Lg) and mirror side effects further complicate the detector normalization procedure. We used a combined iterative approach to "flat field" the water leaving radiance (Lw) and aerosol radiance (La) fields thereby minimizing the sensor characterization errors via atmospheric correction during the normalization procedure.

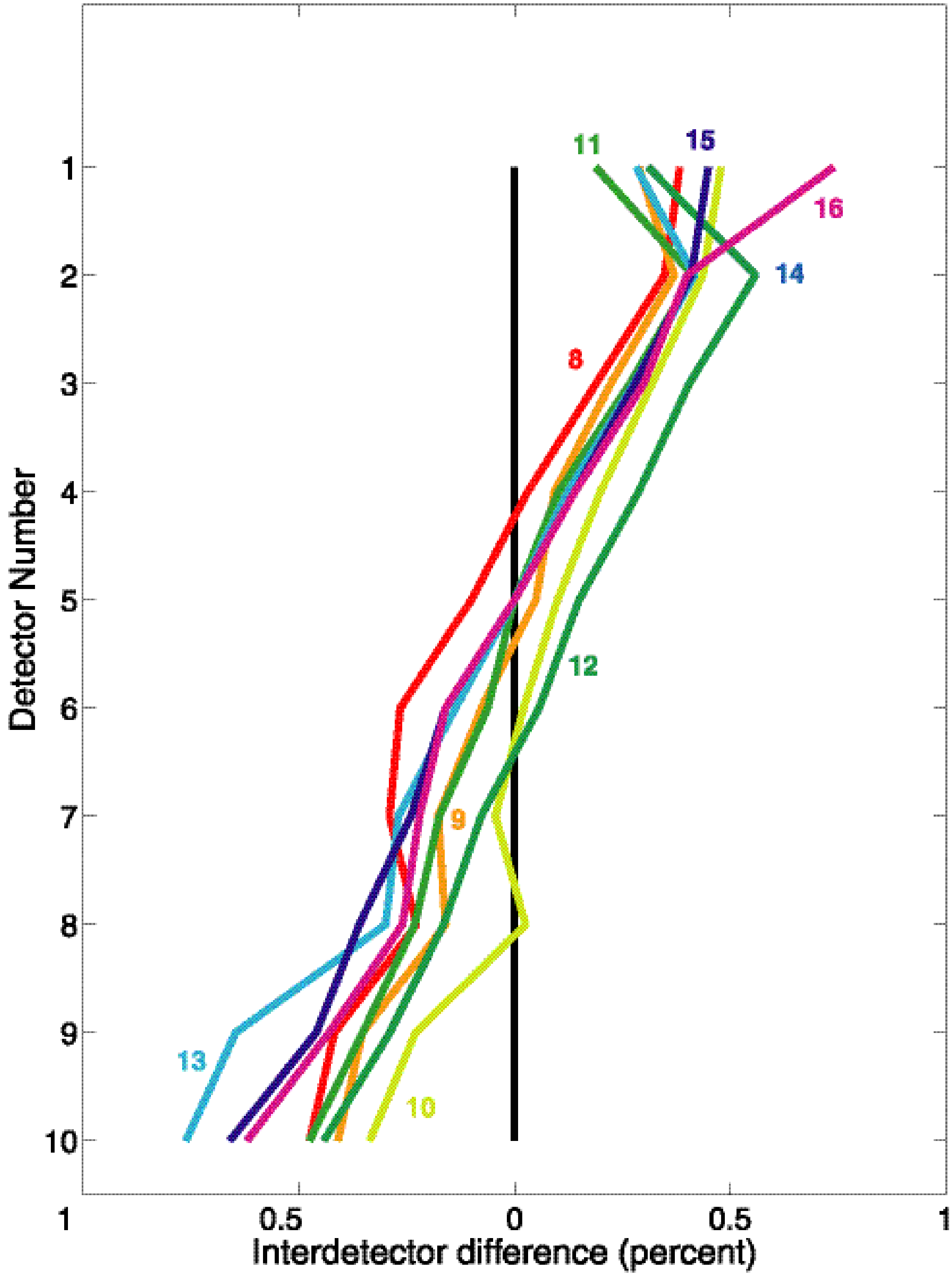
Iterative steps in characterization/initialization:

1. Remove Response versus scan angle (RVS).
2. Remove Polarization effects.
3. Adjust detector gains by evaluating Lt.
4. Remove sun glint.
5. Filter aerosol radiance (La) at 750nm and 865nm prior to epsilon calculations.
6. Evaluate resulting satellite Lw fields propagated to the sea surface.
7. Adjust Lt scaling factors based on inter-detector differences in satellite Lw.
   (Lw at detector x - Lw at reference detector 5).
8. Repeat step 2 through 7 until detector differences in Lw's within a given band approach zero (<0.0003)
9. Adjust overall band gains and biases using in situ and satellite matchup observations

<u>-Inter-Detector gain adjustments</u>

Figure 3 shows a plot of the at-launch relative response of each of the 10 detectors. A general increasing linear response from detector 1 to detector 10 on the order of ~1% is present in all bands. The black line represents the inter-detector response after gains were adjusted by normalizing response to detector 5 and filtering La.

**Figure 3. Percent inter-detector modal differences for each visible band.**

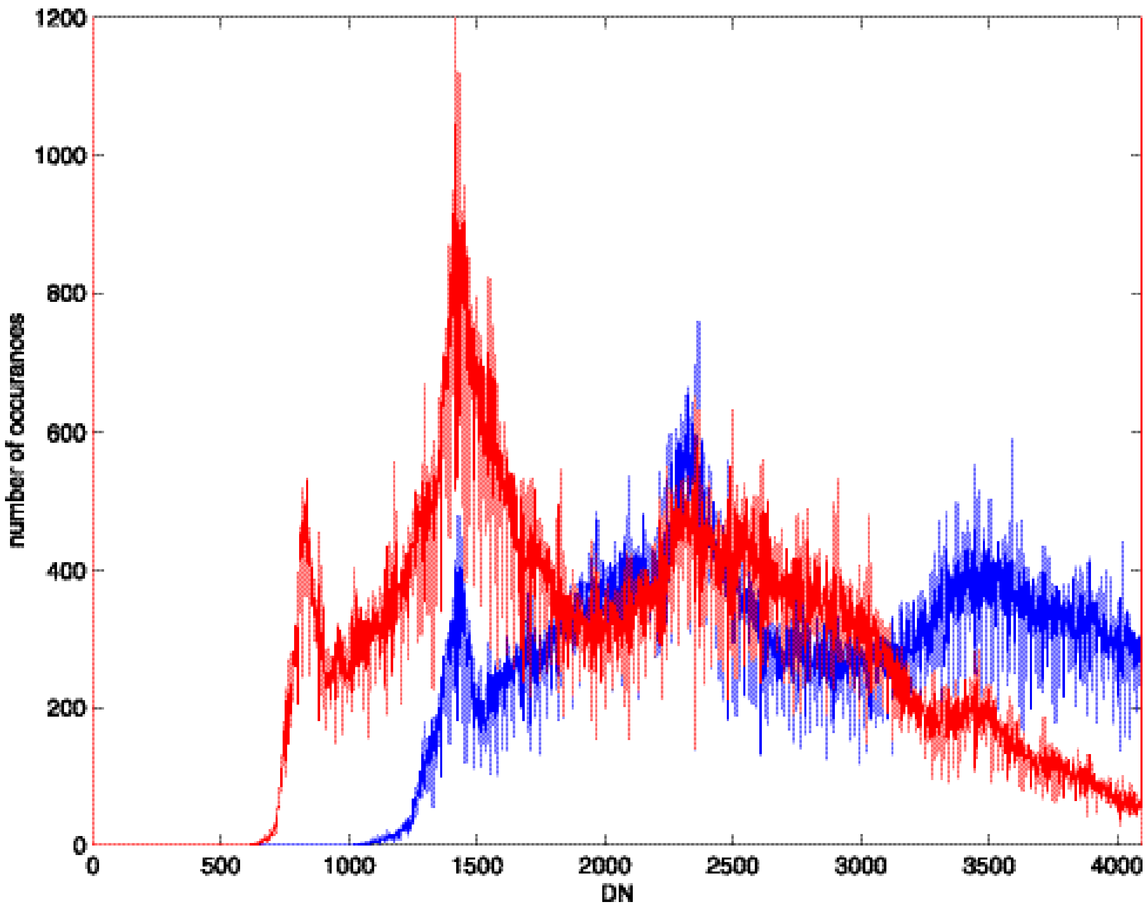


Detector Number
1
2
3
4
5
6
7
8
9
10
1
0.5
0
0.5
1
Interdetector difference (percent)
8
9
10
11
12
13
14
15
16

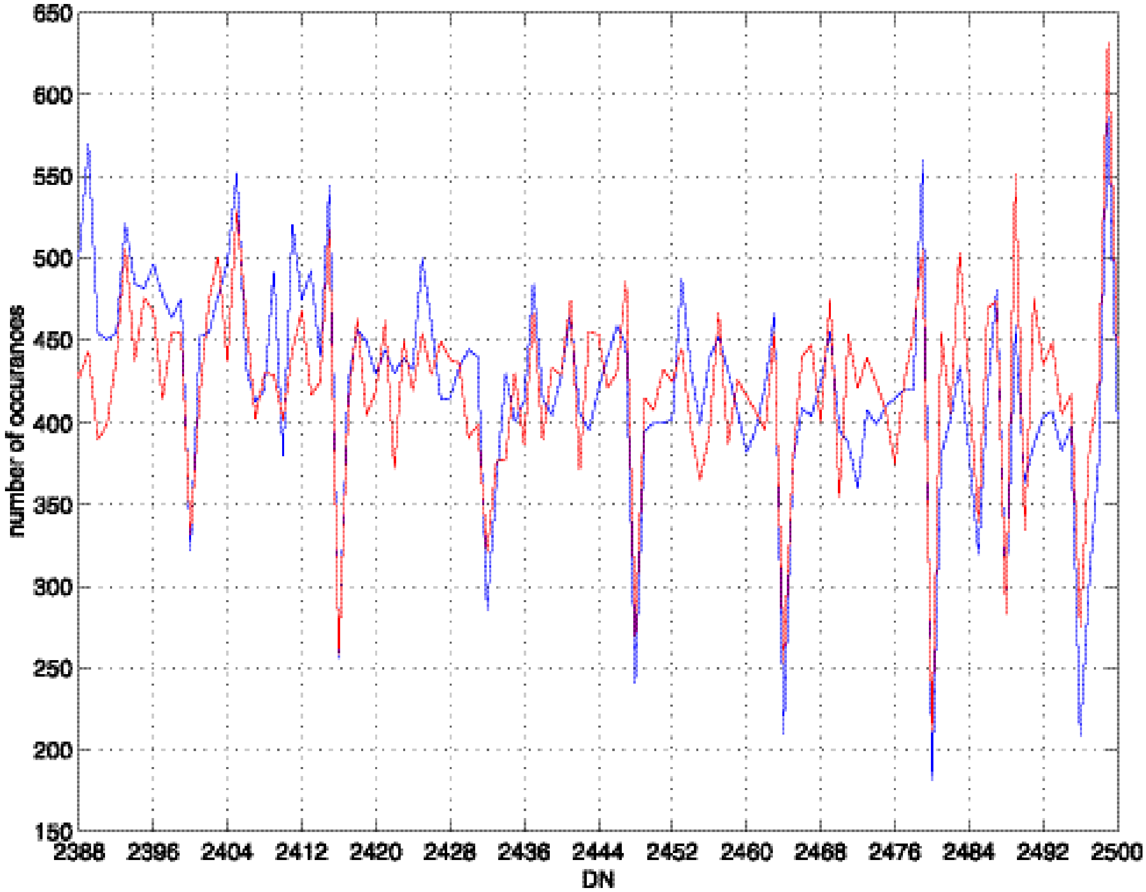
-Digitizer noise

Examination of digitizer counts demonstrates noise in the sensor A/D conversion Figure 4. The expanded scale shown in figure 5 clearly shows 2n –1 -> 2n transitions. This digitizer noise causes the La fields to be quite noisy and is problematic for the atmospheric correction.

**Figure 4. Histogram of digitizer counts.**




**A. full range of digitizer counts**




B. **expanded view of 2000-2500 count range**

-<u>La band filtering prior to epsilon calculation</u>

La is a large fraction of the Lt in the Lw wavebands, as a consequence it is critical that the La fields and therefore the resulting epsilon and aerosol model selection be noise free. Any noise in the process will propagate bad La's into the Lw computation (Lw = Lt - La - Lg).

To mitigate the noise problem we filtered the 750nm and 865nm wavebands before calculation of epsilon. Filtering of the 750 and 865nm bands is applied only during the epsilon calculation to select the appropriate atmospheric model. The input to the epsilon calculation is the 750/865nm ratio. Filtering these wavebands results in a more uniform ratio across the scene and produced less noise in aerosol model selection. To estimate La at the Lw bands, we use the unfiltered La865.

We investigated several filtering techniques to produce uniform La750/La865 fields. We tried the following.

a) 3x3 pixel average
This option suppressed noise but was sensitive to erroneous detector readings (e.g. gains, clouds, digitization errors)

b) Median filter
The median removed problematic outliers but was sensitive to the distribution within the 3x3 box.

c) Median filter with nearest data neighbor averaging
The best approach to creating a nearly noise free ratio for the epsilon calculation was to average the median value and the two data value nearest neighbors in each of the La750 and La865 wavebands. The smooth fields are shown in figure 5.

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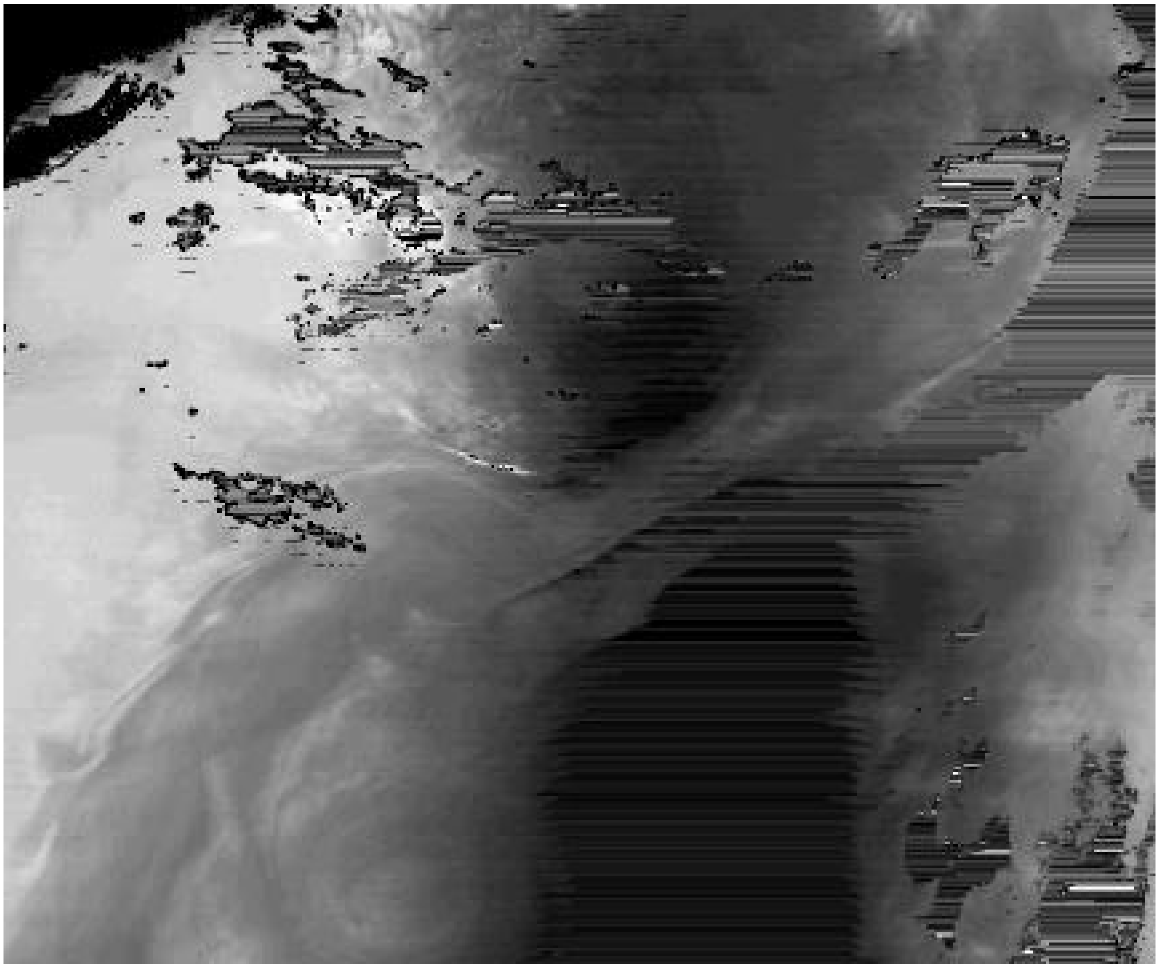


**Figure 5. Epsilon 78 using filtered La 750nm and La 865nm in the calculation. Gray scale: light -> dark decreasing values.Striped areas are clouds and glint.**

## Spectral gain and bias adjustments

Setting of overall band gains:
Aerosol bands: Adjusted gain for band 15 (750nm) relative to band 16 (865nm) to produce "proper" aerosol model. Proper means selecting a model set that deconvolves La from Lw fields and fits expectations as to the aerosols likely to be present in the region. We adjusted the relative balance between bands 15 and 16 until the La865 fronts seen in the East coast image (figure 7) were removed from the Lw fields (figure 2). These gains were then applied to Hawaii

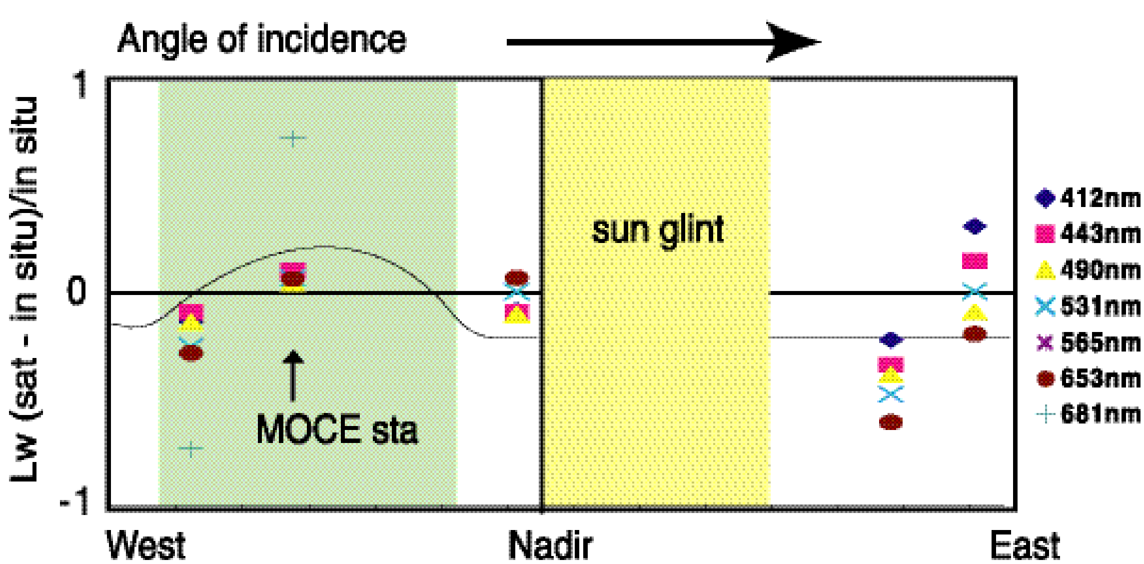
granules to verify that the relative balance determined from the East coast also produced consistent aerosol models in open ocean regions.

Visible bands (blue, green, red): Compared satellite and in situ observations from the MOCE-6 ship and Hawaii MOBY optical buoy observations. Adjusted satellite sensor gains to obtain Lw agreement.

Lw to La bands: Previous ocean color sensors only required relative calibration between the La and Lw bands. The MODIS Fluorescence Line Height (FLH) product requires an absolute calibration between band 14 (667nm) and band 15 (765nm). We used the FLH and FLH baseline calculations in regions known to be without FLH (Hawaii) to verify that the relative band 15 and 16 gains adjustments produced equivalent fluorescence height and baseline retrievals (i.e. FLH - baseline = 0).

<u>Cloud test:</u>
A pixel is flagged as cloudy If the surrounding 3x3 pixel box has a Lt678 min-max > 6.0W/m2/str

Figure 9. % MODIS - MOCE in situ nLw



**Beta products**:

Beta products are derived from at-launch preliminary algorithms and are used for evaluation purposes only, and should not be used by the general community for rigorous scientific analyses. These beta products are not certified with respect to accuracy and/or uncertainty. We estimate that Beta products will be produced operationally though May 2001. The Ocean's team plans to release a quantified Quality Status summary report and error budget for A-side Beta products in mid- April

Known problems identified in Beta products to date include;

- Not calibrated

A preliminary calibration was performed using April 2000 in situ data. This calibration became operational for data-days September 15, 2000 (259) through October 30, 2000 (304). However, while this April calibration performed reasonably well on April test data it has proven unsatisfactory when applied operationally to the period September 15, 2000 through October 30th, 2000. This has been traced to problems both in Level 1b data, and other Level 2 artifacts given below that have been identified but are not currently understood. Following the April 2001code revision, we have the ability to easily swap Ocean calibration LUTs, allowing more rapid promotion of revised time dependent calibration tables to operations. Some improvements in the accuracy of operational Beta products should occur as calibration is adjusted in a time dependent fashion.

- Other Artifacts currently identified

Response versus scan angle (RVS)
A noticeable east-west difference across the scan line is present and is more pronounced at low latitude. This east-west difference includes a spectral component and is most evident in the Lw412nm and Lw443nm bands. The impact on specific products is highly dependent on choice of spectral bands.

The viewing geometry for MODIS is very different than previous ocean color sensors; we believe that a portion of the RVS artifact may be traceable to a bi-directional reflectance (BRDF) effect not currently included in any of the beta atmospheric correction algorithms. The work of Ken Voss suggests that maximum variation across the scan due to BRDF is expected to be on the order of 10-15%, and thus, does not fully explain the magnitude of the RVS artifact present in the MODIS data. Continued analysis is needed to fully understand the RVS issue.

Beginning on products for data-day October 10,2000 this problem was masked in level-3 Beta operational products. That is to say, only the western 1/2 half of each level-2 swath (pixels 75 to 667) is included in Level-3 products, obviously this reduces coverage in daily files.

Mirror side differences
Gains are not completely balanced between the two mirror sides resulting in striping. The mirror side differences become more pronounced at higher scan angles ( >55 degrees satellite zenith angle; +/-75 pixels on each end of the scan line). These pixels are currently being masked in the level-3 operational products as of data date October 10,2000. These mirror side differences are spectrally and temporally dependent!!!

Angle of incidence (AOI)
Detector response appears to change as a function of mirror AOI, increasing stripes.

Digitizer noise in IR bands
A-side electronics introduce noise in the sensor A/D conversions, affects 2(n-1) -> 2n transitions. Additional filtering to remove this noise will be required. B-side electronics have been found to reduce digitizer noise and revised detector bias settings produce fewer dead detectors.

Channel cross-talk; electrical and optical have been identified in the L1b product

Inter-detector discrepancies

The gains on the 10 detectors in a scan are not completely finalized. The imbalance between detectors results in striping and is accentuated by differences in mirror side and at high scan angles. Uncorrected inter-detector discrepancies were severe on the A-side electronics following instrument problems that occurred on June 22, 2000 (day 174) and were found much improved on the B-side, although the problem still remains on a lower level,

Polarization and sun glint corrections

Current polarization and sun glint corrections are only approximate and will be refined in the future. Insufficient polarization corrections may also be implicated in the magnitude of the RVS problem.

- Impact of known artifacts on level 3 global images

Due to the large number of identified artifacts there are very few high quality pixels at level 2. This violates a fundamental assumption of the current time and space binning rules and algorithms used to create global level 3 products. In a theoretical sense as a product progress to lower time and space resolutions both the accuracy and the quality of the retrievals should increase. This is not seen in the Beta products to date, due to the fact that as the product moves to decreasing resolution the number of level-2 pixels summed per bin increases, and results in large numbers of poor quality pixels biasing the signal of the few with high quality. The current binning algorithm has the ability and does attempt to "filter" out bad level 2 pixels, for a single level-3 bin only candidate level-2 with the highest assigned quality level available are summed, but adjacent bins may not be of equal quality. One solution is to operationally bin only pixels assign the absolute highest quality level (quality level=0) and not the "best" available. This restriction will improve the accuracy of the products but will severely restrict geographic and temporal coverage; many oceans bins will be empty at the 4km time resolution of daily. Currently the user can accomplish this with the Beta products to date, if the user filters the data using the archived bin quality level maps distributed with the product and the cloud mask.

Provisional level 3 products

Provisional Level 3 products are expected in operations by June 1,2000. These products will show a dramatic improvement in the overall accuracy of the global products; however, currently this can only be accomplished by a dramatic reduction in the global coverage through the use of very restrictive binning rules to mask out problems.

During the next several months the Oceans team will make the following improvements to bring operational products to Provisional status:

A. B-side calibration of Lw’s and brightness temperature using

Preliminary (#B1) December 2000 cruise data
Time dependant calibration refinements (#B2…) referencing MOBY buoy, MAERI Explorer cruise data. Calibration refinements will be rapidly promoted into operations as they become available.

B. Improved product specific flags and quality level assignments used by binning algorithms. Ensure that pixels with inaccurate retrievals are not included in the level-3 global products and are assigned to quality level 1 and greater. Explore defining additional quality levels internal to ocean code to better identify potentially useful pixels.

C. Implement highly restrictive binning rules to mask out identified artifacts that are poorly understood and not adequately captured by existing quality and product specific flags.

D. Mitigate the impact of known but poorly understood artifacts in derived products through the use of additional calibration coefficients developed from comparisons to SeaWiFs and AVHRR equivalent products, (i.e. force agreement)

Operational 1km Level-2 products will remain at essentially the Beta level, although improvements will be evident due to improved calibration and detector balancing performed as part of activities outlined in above in A. The majority of known artifacts will likely remain in these products. Only level-3 4km and lower resolution products will be promoted to Provisional status as a result of the above changes.

Science quality products:

Science quality operational products are expected to be produced beginning in late December, 2001. Increased coverage and promotion to operational Science quality status will only be possible with a more complete understanding of the known artifacts and correction of these problems in level-2 granules, allowing use of more of the scan.

When these artifacts are corrected in the l2's ,in the absence of clouds, products will show a significant improvement in the coverage of high quality populated bins at Level 3 and may have additional ocean quality levels flags to enable users to be able to make rational choices between coverage and defined accuracy. Additional quality levels are needed due to the range of application and uses of science quality products. For example users primarily interested in tracking frontal features may desire the ability select increased coverage at the expense of some of the accuracy, while other application need only the most accurate data.

To accomplish this transition to fuller coverage the Oceans team will focus activities in the following areas.

A. Intensive work in conjunction with MCST to understand RVS , mirror side, and AOI artifacts. This will require detailed analysis of a time series of highly partitioned test products to attempt to isolate each artifact independently. As an understanding is gained for each artifact we will incorporate changes in the atmospheric correction and Lw code to correct the problem.

B. Continued refinement of calibration via additional validation cruises and in situ matchups from buoys.

C. Time series analysis with matchups from in situ buoy and cruise data, AVHRR and SeaWiF sensors.

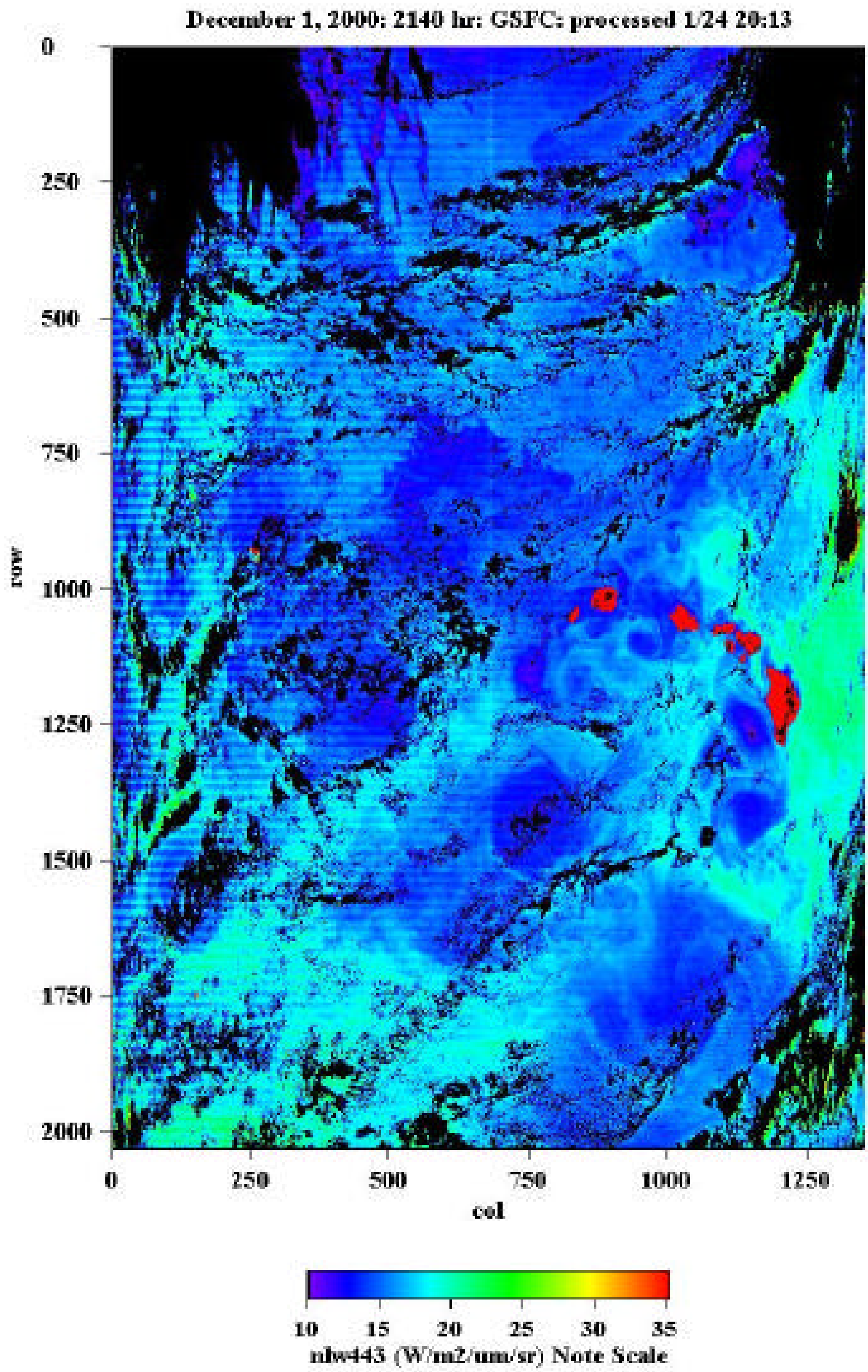
D. Derived product algorithms will be refined and updated based on experience gained with Beta and Provisional products and improved Lw inputs.

**Algorithm updates and code maintenance**

Code changes relating to b-side provisional product generation.

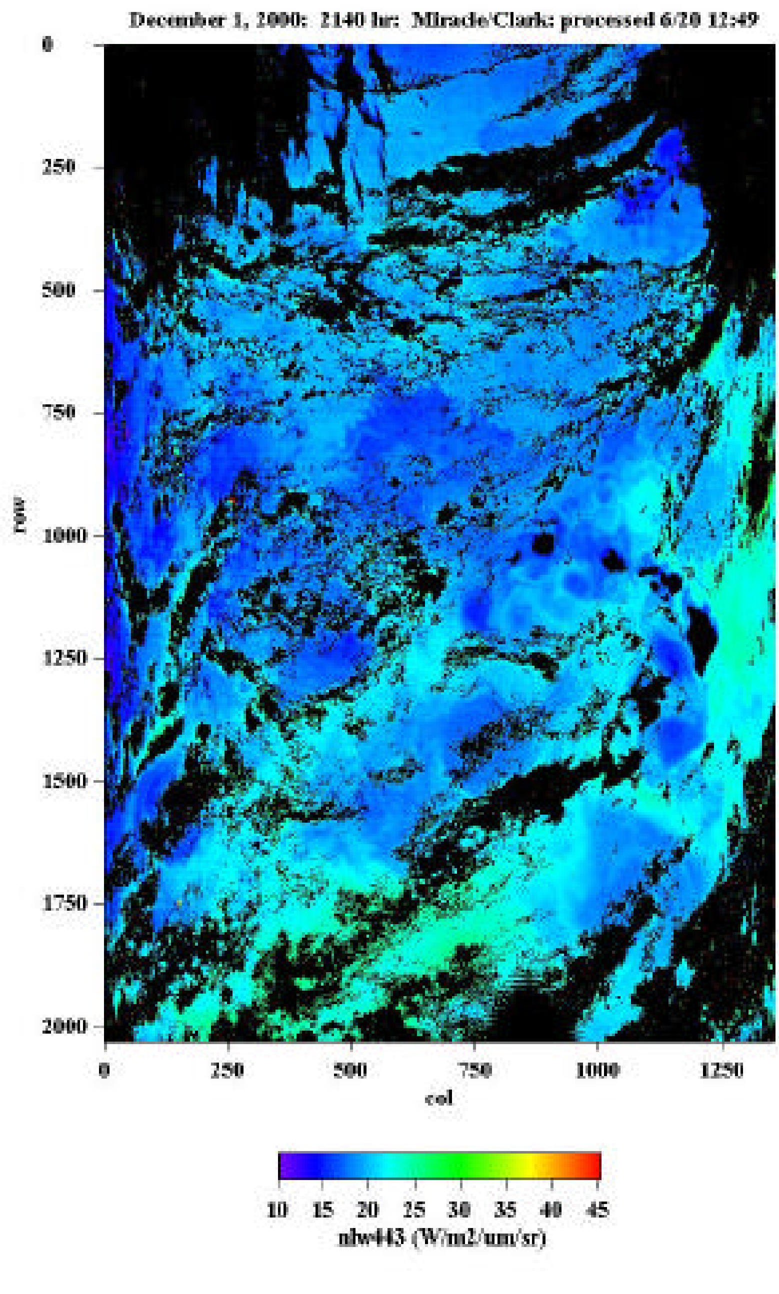
Polarization:
Selection of the plane of polarization for corrections has been based on imprecise pre-launch characterization data and quasi-empirical sensitivity studies using different polarization angle reference coordinates in earlier versions of the PGE. When these tests were repeated in late June, in the process of refining the calibration LUTS for the Version 3.1.3 code (current operational version) following sensor gain initialization and vicarious calibration against MOBY, they showed marked improvement with further polarization plane adjustment.

A Level 2 Beta image over the Hawaii calibration site (Figure 1) shows the presence of striping and zipper effect at nadir.
Figure 1: Beta processing



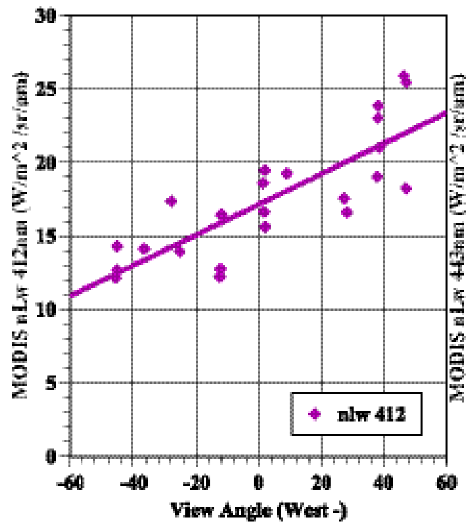

The revised polarization tables and b-side LUTs remove much of the striping and the zipper at Nadir had disappeared (Figure 2). The same granule as shown in figure 1 was processed at RSMAS with the revised PGE code.

Figure 2: Provisional product revised PGE code

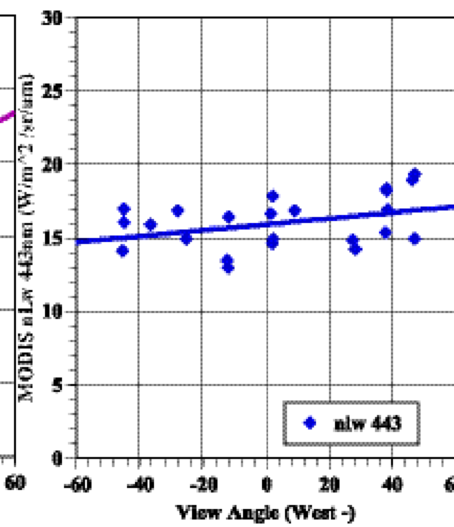



These calibration changes for the provisional code also include a cross scan correction. The figure below shows the cross scan error in the beta processing. Much of this cross scan trend is reduced in the provisional code

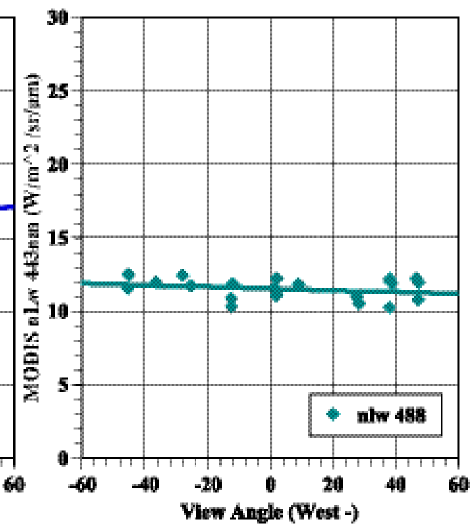
# MODIS Viewing Angles vs Spectral Bands for Mirror Side 0 (b electronics)




f(x) = 1.04E-1*x + 1.71E+1
R^2 = 6.67E-1




f(x) = 2.01E-2*x + 1.59E+1
R^2 = 1.39E-1




f(x) = -5.90E-3*x + 1.16E+1
R^2 = 7.45E-2

**New algorithms integrated:**

In addition to sensor calibration and characterization several new product algorithms were integrated in to the ocean code.

-Ocean Color

Revised algorithms currently in test mode included a new 3 banded Coccolithophore algorithm based on bands 6,7 and 8 from Howard Gordon and Wm. Balch, a new fluorescence line height algorithm that computes the FLH as the difference between the observed and the modeled nLw at 678 nm using the Coccolith algorithm to estimate the "observed" nLw. The Coccolith algorithm is described in Gordon et al. Geophys. Res. Lett. 28, 1587-1590, 2001. It is extended to model the nLw at 678 in the absence of fluorescence. These new FLH and Coccolith methods are being refined and evaluated by Gordon, Balch, and Abbott for possible future operational use. A new test algorithm for absorption of Phycoerythrin (Hoge V3) was also integrated and includes 2 new test products total backscatter and concentration of dissolved organic matter. These new products are under test evaluation.

In addition to the above “test “algorithms major revisions to the Ken Carders 3 band Chlorophyll algorithm (Carder V2) were incorporated into the provisional code. The revised chlor_a3 improved the handling of the nitrogen deficit term of the algorithm and produces superior results compared to the Beta V1 version. The SeaWIFS OC3M algorithm was integrated into the provisional code and replaces the OC2V2 algorithm present in the Beta code for the seaWIFS chlor_a2 product. Based on comparisons to SeaWIFS data by Janet Campbell, the OC3M algorithm produced MODIS retrievals more similar to operational SeaWiFS OC4V4 same day retrievals.

-SST

*Thermal infrared algorithm (10 -12 µm): modis_sst*

The basis for the MODIS V.2 SST algorithm is the Miami Pathfinder SST (mpfsst) algorithm, developed at UM-RSMAS [Kilpatrick et. al., 2001], which is:

$$modis\_sst = c1 + c2 * T31 + c3 * T3132 * SST_{guess} + c4 * ( \sec(q) - 1) * T3132$$

T30 is the band 31 brightness temperature (BT)
T3132 is (Band32 - Band31) BT difference
$SST_{guess}$ is the first guess SST
q is the satellite zenith angle

The algorithm differentiates atmospheric vapor load using the difference between the
brightness temperatures (T3132 ) for the 11 and 12 µm bands (MODIS bands 31 and 32).
The daytime SST algorithm use the Reynolds weekly OI as the first guess SST, while the nighttime algorithm uses the SST4 product as the first guess SST.

Ideally coefficients (c1, c2, c3, c4) are determined by regression analysis from radiative transfer simulations or a large matchup database of satellite brightness temperatures and *in situ* radiometric measurements. Until a large number of MODIS matchups are available coefficient estimation for the Provisional algorithm currently uses a regression analysis between MODIS brightness temperatures and Pathfinder SST products.

*Mid-range infrared algorithm (3.7– 4.2 µm): modis_sst4*

The MODIS is the first spacecraft radiometer to have several infrared bands in the 3.7-
4.1µm atmospheric window with characteristics suitable for the derivation of SST. This
window is more transparent than that at 10-12 µm (bands 31 and 32) and provides the
opportunity to derive more accurate SST fields. Although heritage instruments have
had single channels in this window, the data from which have been used in conjunction

with those from the longer wavelength window to derive SST [e.g. Llewellyn-Jones et
al., 1984], MODIS provides the first opportunity to derive SST using measurements in
this window alone.

The main disadvantage of this spectral interval for SST measurements is the contamination of the oceanic signal by reflected solar radiation in the daytime. Because of the wind roughening of the sea surface the reflection of the insolation becomes spread out over a large area when viewed from space – the sun-glitter pattern [e.g. Cox and Munk, 1954]. This can render a large fraction of the daytime swath unusable for SST determination. As a consequence, algorithms using measurements in this interval have been restricted to night-time use, or to those parts of the daytime swath where the risk of solar contamination can be confidently discounted. Thus, while the MODIS bands 20, 22 and 23 offer radiometric advantage over bands 31 and 32, they cannot offer the day and night applicability of the longer wavelength bands. The SST4 algorithm is based on a linear formulation which is:

$$SST4 = c1 + c2 * T22 + c3 * (T22 - T23)$$

T22 is the Brightness temperature in band 22
T23 is the Brightness temperature in band 23

Coefficients (c1, c2, c3) for the at-launch Beta SST and SST4 algorithms were estimated by radiative transfer modeling. For reasons that are currently unclear, this modeling approach produced poor results and very large biases (~4C) as a function of scan angle (SST4) and (~2C) over the 0-30C temperature range for SST, when compared to Pathfinder SST. Coefficients for the Provisional algorithm were therefore developed using a regression analysis of brightness temperature and Pathfinder SST at selected locations and MODIS viewing geometry. The regressive approach to coefficient estimation has dramatically improved both the SST and SST4 products. Generally the Provisional SST4-SST MODIS product difference is <0.8$^{o}$C. We continue to investigate why the radiative transfer method did not produce reasonable results.

**Quality control and assessment:**

-Science QA tools

Parallel processing of selected days and at the Miami SCF
Complete archive of MOD1ss and ancillary data. Data have been processed at Miami for:

> Comparison to MODAPS production
> Analysis of select L1,L2 and L3 granules to understand sensor characterization and calibration
> Comparisons to other sensors e.g.. SeaWiFS and AVHRR Pathfinder SST
> Evaluation of QC products and various pixels level Flags
> Testing of new algorithms

The Miami processing can be viewed on the web site
http//miracle.rsmas.miami.edu
The Miracle web site http://miracle.rsmas.miami.edu has been upgraded with several new viewing tools. Products can be viewed at the 36 and 4km global map level and regional selection boxes allow direct visualization of the high resolution level 2 products for the geographically selected region. Data can be masked by selecting various quality levels and or common or product specific flags from a menu prior to generation of the image on screen.

-Data Archive at the Miami SCF and GDAAC Issues:

1. The Miami SCF archive of MOD01ss was inventoried 11,199 were found to be missing from the Miami subscription archive but present in the GDAAC archive. The GDAAC filled the request to resend these granules to Miami.
2. A total of 7,561 MOD01 granules were not present in the MOD01 metadata publications but were present in the Miami MOD01ss archive. The GDAAC has been notified of these lost granules and the issue is under investigation to determine if they are truly missing or if there is some problem with the metadata publication files.

3. 1,163 MOD01 granules in the GDAAC inventory were never processed by PGE 71 to create MOD01ss and are therefore missing from the Miami SCF archive of MOD01ss granules.

4. Several months of Attitude and ephemeris data missing from the Miami archive were resent by the GDAAC.

-Tracking of PGE02 LUT's

The Miami SCF has been participating in weekly telcons with MCST in regard to MOD02 calibration tables. The Miami SCF monitors the delivery and installation into operations of all changes to PGE02 LUT's. The Miami SCF was the identified that the wrong PGE LUT V3.0.0 had been delivered to GDAAC I&T and installed into operations. Miami receives advanced tables directly from MCST for testing prior to delivery to STIG. Miami also receives and automatic push from STIG when new LUT's are received for integration into operations. Miami compared the two LUT tables and found that they did not match. MCST and STIG were notified of the discrepancy. MCST confirmed the error in the delivery and the correct tables were redelivered by MCSST to STIG.

-Storage of QA results

Pixel level information (set during processing stored as an SDS in the HDF file)

Common flags
Product specifc flags
Quality levels

Granule level (QA metadate updates after ingest)

Science QA flag
flag explanation
Currently we still cannot update the QA metadata at the DAAC and rely on the known problems page to communicate this information to the user

-Pixel level flags

Science Quality level definitions were refined for ocean color and sea-surface temperature products. A new cloud detection test was developed based on 678 reflectance values. This test was found to successfully identify clouds for both ocean color and SST day time products. Many of the common and product specific flags have been modified and thresholds revised. These flags are used in determining the value of the quality level at the pixel level.

**QA Communications to the end users**

Provided content and pages for the MODIS OCEAN QA web site these web documents include:

Disclaimer and known problems web site
- General disclaimer and product status
  - Beta, Provisional and Science
  - Listing of known problems under investigation
  - Listing by product of QA_science flag and flag explanation gives dates when QA flags change and period

Oceans web pages http;//modis-oceans.nasa.gov
- general product information and sample IDL codes for reading pixel quality levels, common flags, and product specific flags. Stored in product hdf files
- Trouble ticket web page tracks status of end user reported problems received at the GDAAC

**QA database**

The QA database is a central component in the process of documenting problems in the MODIS oceans data and updating the associated metadata so that this information can be made available to the scientific community. The database provides a repository for QA data on each level 2 granule and global ocean products. Basic QA data consists of flags (pass, fail, and others) and comments at the parameter level. This information is used by associated software to generate metatdata update messages which will be processed at the GSFC DAAC when this functionality becomes available.

-QA database
The system is loaded with L2 and L3 granule metadata from MODAPS and ECS insert metadata publications (containing the ECS UR of the granule). Potential problems are identified based on the analysis of globally mapped daily composites. An email message is generated by the 36Km browser QAdatabase_tool containing the parameter, geographic location and description of the problem and this information is stored in the database. Problems are investigated and the database updated with appropriate QA flags and comments. An associated program will use this information to generate e-mail messages to update the ECS QA metadata ScienceQa_flag and flag_explanation for granules archived at the DAAC when bulk updates become possible in the ECS system.

-System Components of QA Database developed in the last 6-12 months
The programs listed below load and query the database to perform basic operations.

<u>Insert/Update Procedures</u>
L2/L3 Metadata Loader (MLoad) : parses and loads L2 and L3 metadata into the database.

ECS Metadata Publication Loader (MPLoad) : retrieves parses and loads ECS metadata publications into the database.

QA Finger (QAFinger) : parses and loads specific email messages containing QA into the database.

Comment Update (CUpdate) : inserts comments about specific problems from science team members.

<u>Queries</u>

ECS Metadata Update (METUpdate) : generates ECS metadata update messages based on the QA data collected.

Interactive Queries : various utilities support browsing the comments and QA flags.

QAInfo:browse flags and comments on a particular granule.

## Methodology:

MODCOL:

Sue has implemented 16 bit unsigned integers in L2 and map products
in modcol. All miami production is now based on the 16 bit fields.

Various efforts were made to de-trend the modis visible bands:
tried normalize by detector, noisey
tried to normalize by mirror trend, better
then went to 20 detectors, using det 2 side 1 to det 9/10 side 2, worked better for band 8
Trends and offsets remain, continuing serious problems with RVS.

We have implemented and activated polarization using polarization
tables supplied by MCST and analyzed by Gordon. Dennis' moby/moce
data indicates that satellite Lw decreases with increasing AOI.
Tried polarization using as supplied and pi/2 rotated polarization reference;
supplied tables increased Lw with AOI while rotated polarization decreased.
We chose the supplied reference for now.

Supplied polarization tables include data by detector and mirror side for each spectral band. These detector based data increase detector to detector noise. Jim Brown reanalyzed polarization tables, and noted that band 16 reference is 180 degrees rotated from
all other bands. Jim computed 'average' polarization from available
data for each AOI by spectral band. The result is a new polarization

table where the polarization factors are smoothed by AOI and are
fixed for all detectors across both mirror side by spectral band. The revised polarization tables produce stable retrievals across detectors adding radiance as a function of AOI.

We also tested the MCST LUT detector gain, bias. Jim produced a
special version of PGE02 where an average gain and bias was calculated
using the average for all detectors across both mirror sides for a given spectral band. A granule was processed and the mirror side banding compared. Similar banding is seen for both mirror sides, indicating that the mirror side dependent banding seen in the pre-July 31 LUT is a result of errors in the solar diffuser analysis. Mirror side performance is more nearly similar using the July 31 LUT.

New PGE02 and LUT received end of July. Application of this change reduced
detector stripping and irror side trends. Trends remain in bands 15 and
16, order +- 0.5% (- at detector 1 and + at detector 10). Band 14 shows
significant departure from remaining detectors with detector 1-4 low by
order 2%, detector 6 high by 1% and remainder of detectors within
0.5% of detector 5. Ed Kearns is developing detrending coefficients
for bands 8, 14-16, for the new LUTs. These changes, together with
the new PGE02/LUT will be tested using the August delivery for
MODIS Oceans.

Together with Dennis Clark, we have analyzed MODIS Lw retrievals through
comparison with MOCE 6 in situ observations obtained in the Hawaii region.

This analysis suggests that the Lw's on the western side of sun glint and
low AOI and satellite zenith angle and in reasonable agreement (order 20%)
for non-initialized satellite retrievals.  All satellite Lw in this region
(day 102) are high relative to in situ observations.

Satellite Lw decreases in regions affected by sun glint and at high
satellite zenith angle.   The retrieved epsilon  appears high (order 1.1
away from sun glint decreasing to 1.0 as sun glint increases).  Day 102 will
be processed using Seawifs images and seawifs and MOIDS aerosol model
selection will be compared.

Band 16 La calculation: Jim created a new version of modcol.exe
which does atmospheric correction in a slightly different way.
The changes were somewhat significant so we definitely need to run
this version against the previous version to verify the results
are basically the same.  MODCOL was averaging bands 15 and 16, used
the averaged values to select aerosol models, and used the averaged
values to correct the other bands.  MODCOL now averages bands 15
and 16, uses the averaged values to select aerosol models, and uses
the un-averaged band 16 values to correct the other bands.

Ed Kearns examined individual detector offsets and residual mirror
side offsets.  Day 102 in situ and satellite Lw were compared.
The difference in Lw-sat and Lw-MOS (MOCE6) was divided by Lt

(neglecting attenuation) to obtain trial correction of Lt. Average for all water bands is 2%. Atmospheric correction channels were lowered by 3% for 765 and 2% for 865 assuming that the Radiance levels were scaled equivalently to the Lw bands and an additional quess reducation added to 765 to lower epsilon values that average 1.1 in open ocean away from sun glint and 1.2 in vog area off Hawaii.

Sue implemented 16 bit scaled integers for L2 files replacing the previous real values. After test runs the scale factors have been adjusted, with 0.001 slopes for derived quantities and 0.01 slopes for QC quantities including Lt.

Bob Evans worked with Dennis comparing MODIS with MOS in situ observations. A rough initial comparison suggsts that all Lw bands (8-14) have high Lw relative to MOS that translate to approximately Lt too large by 2%. This from a cheap calculation neglecting Lw attentuation to the satellite (% correction -> (Lw[sat]-Lw[mos])/Lt).
Since all water bands show essentially the same percent correction, we will try increasing the two La bands by 2% vs decreasing the Lw bands by 2%.

The atmospheric correction overcorrects as the scan approaches the sun glint region in all bands suggesting that the La in the sun

glint region is too large. Should we include a 'sun glint' term
to reduce the Lt-Lr-(Lg) leading to La?
The problem is that even if we get the glitter correct, we don't know what
transmittance to use. Another possibility is to look closer to the glitter
pattern and assume La ~ 0, giving lg throughout the spectrum. Then ratios of
Lg's will give the appropriate 1-way transmittance (surface to satellite).
All this assumes of course that cox-munk is correct.

Another problem appears to be that at high satellite zenith angles,
at least for the blue bands, the correction leads to low Lw.

We have received a new L1a to L1b program from MCST that reduces
detector trends and are working on removing the remaining trends.
Band 14, 678nm, has additional offsets not seen in the other bands.
We are using the polarization correction where Jim has averaged
the polarization corrections for all detectors and both mirror
sides for each spectral band. In addition the phase for band 16,
865, was flipped to match the trends seen in the other 8 bands.
We also reduced Lt765 by 1% relative to Lt865, which lowered eps
by ~0.04, and lowered models numbers by ~4.

We also processed SeaWiFS day 102 to check selected aerosol models,
and then tried to adjust band 15 relative to 16 to achieve similar
MODIS model selection.

After these changes, we still had detector 1-10 trends in Bands 15
and 16. We tried a det 9-2 trend correction taking data from the

pre-sturation sun glint area. A rough check seems to indicate that
the required shift in the low radiance areas appears to be equivalent
to what is needed in the high radiance area but the low region does
not provide sufficient precision to resolve the gain shift.

The La gain shift trial showes that the correction is spectral, close to matching at 551 with increasing Lw(sat)-Lw(mos) with decreasing wavelength; the 600 nm wavelengths went negative.
Checked MODIS models with seawifs; Seawifs day 102 east of Hawaii
lead to these general impressions. Models for both instruments in the
same range chose models 9-12 in open ocean. Vog region shows lower
model numbers, e.g. 6 eps=1.06. Behind the big island, the model
numbers increased to 13,14 and epsilon increased to 1.22. Open
ocean MODIS epsilon is order 1.10-1.13 vs. Seawifs 1.05-1.10. We
then processed Seawifs days 101 and 103 to get better coverage over
islands and the MOBY site.

Art Gleason developed a Matlab proceedure to extract and compare
MODIS and MOBY/MOS Lw, compare total and water leaving radiance
and compute percent change assuming diffuse transmittance =1.
Computed 3x3 to 9x9 averages, differences tend to increase with
increasing box size but the results are dependent on spectral band.

We then decreased La gain to 1.0, which decreased the Lw bands by

2.0%. Model selection appeared governed by satellite zenith angle:
the larger the angle the larger the model number. Note that Seawifs
day 102 viewed Hawaii at extremely large zenith angles. Day 103
epsilon values also lower, order 1.13 vs MODIS 1.23 west of Hawaii.

We then set the Lw band cal factors to 0.98, 6xx and 7xx to 0.99
and 865 to 1.0. This resulted in Lw(412) -> 17.4 vs 17.7 for La to
1.02 and 18.6 with no gain correction. The model numbers were
lowered, more like seawifs near nadir and eps decreased to 1.12
vs 1.23 behind Hawaii, 1.09 between islands.

The next test was to reduce La(765) to 0.98, and also reduce 6xx nm bands
to 0.98. Lw for 6xx nm using 0.99 was too high, (.4,.25). This
resulted in a lower model number and a lower eps by another 0.04.
Now there was the appearance of residual La in Lw fields. Next
test is to increase La(865) to 1.02 and La(748) to 1.0. Other
corrections remain at 0.98. The result was that
Lw=(18.4,16.8,12.2,4.75,3.5/0.15,0), eps=1.09, model=4. Use of
La(1.0,1.02) results in model 1 over most of western part of image.

Art Gleason computed Lw band multipliers, bands 8-12 needed an
additional 2% decrease in Lt, or total of 4%. 667 decreaaed by 1%
to 0.97, 678 increased to 1.01. However, directly applying corrections
caused an overcorrection, Lw too small for transition of 0.98 to

0.96. Lw for all bands was too small at large western zenith angles.
Eps was 105 at western edge, increasing to 106-108, then decrease
to 101 at sun glint, 1.20 directly west of Hawaii. Model number
higher in areas of high eps.

Next run: since epsilon and model numbers co-vary, increasing model number will remove move La in mid image relative to high
zenith angle. Change La gain factors to (0.99,1.0) for 7,8nm;
change Lw gains to 0.97. Reduce computed gain change by 0.5.
6xx->(0.98,0.99). The result was that the Lw was almost correct
for green and blue, high for 6xx, e=1.10, m boundary 4 or 9.

Next we reduced 6xx by 0.5%. We will need to consider how to set
748 re 6xx bands to produce good flh baseline. 0.975,0.985 leads
to negative 6xx Lw, increase to 0.978,0.988.

We began processing all MOCE6 days to examin cross scan behaviour,
eps, and model selection. We processed 102 to obtain Lg field. Examined
Lg, La(865), Lw(551) for various points leading to sun glint region.
Order 10 to 20% Lg required to correct loss of Lw. Howard suggested
computing relectance for each of the bands, and to look at the ratio of
reflectance for band combinations.

FLH have been working on a first start of the MODIS initialization
using Dennis' Hawaii data. Detector stripping, mirror side, sun
glint and high satellite zenith angle continue to pose problems.

After Ed Kearns and I reworked our cal proceedures following a new
set of instrument adjustments we encountered a quite different behaviour for band 14 vs the other 8 bands.  Turns out that 14 was
never calibrated, in part due to the band saturating when viewing
the solar diffuser.  The end result is that detectors (scan lines) 1-3 differ by order 2% in Lt from the other detectors.  This constitutes a significant source of the FLH banding.

The other challenging aspect of the FLH is forcing agreement between the 667
and 748 bands to yield a near 0 FLH in the 'open ocean'.  I then will have
to adjust 865 relative to 748 to provide the appropriate aerosol models.

Examined glint field, exhibits equivalent saw tooth radiance field
as seen in total radiance.  Examined satellite azimuth and zenith angle fields.  Azimuth shows same pattern as glint, e.g. saw tooth
with trend across 10 detector scan.  Disabled variable angle fields
by selecting values corresponding to detector 5.  Banding in these
fields was removed but increased in Lw fields.  In addition abrupt
changes in Lw values across changes in aerosol models remained.

To address the abrupt Lw changes, aerosol model range was restricted
to models 1 and 2 as suggested by Seawifs imagery for open ocean
near Hawaii.  East coast image for day 129 was processed and found
to be free of discontinuities in Lw fields present with 16 models

enabled suggesting that at near nadir viewing where both viewing
geometry and Lg are rapidly changing, changes in model and epsilon
selection are not sufficiently smooth to permit atmospheric correction
without discontinuities.

Angle variation is restored to MODCOL. A Lg term will be added to
the computation of La with a selectable transmittance factor.
Expect that glint and the variable geometry caused by presence of
multiple detectors and rapidly changing viewing angles near nadir
and consequent changes on where the Rayleigh and aerosol phase
functions are sampled are at the source of the large discontinuities
seen in the Lw fields. With luck, including the Lg term will remove
this factor in epsilon/model selection and reduce the excess La
that also forces the Lw to low values with increasing glint

Jim added Lg to aerosol computation: La=Lt-Lr-Lf-tgLg where tg is
transmittance factor, four run with tg (glintsc in modcol)
[0,0.5,1.0,2.0,3.0] for day 102 will be used to examin effect.
Lw_551 effects at the 0.05-0.10 w/m2.um.sr are seen at pixel 534
with Lg=1.4. Lw at edge of glint saturation; Lw_551 (681,1394)
[tg=0,lw= 0.2; tg=0.5, 1.2; tg=1.0, 1.65; tg=2.0, 2.55; tg=3.0].
tg=2.0 provides near total correction up to the point of glint
saturation. There is a spectral trend, over correcting at 678
and undercorrecting at 412. spectral trend monotonic over spectral
range.

We also processed the east coast, day 129 image selected by
Janet,
using tg=2.0 and all models. The image processed cleanly,
with no
discontinuities. Chlorophyll features are quite striking; for the
first time we can see complete, continuous structure across ring
west, but in glint pattern. And chl east and west of glint is of
the same order. Now need to work on spectral glint trend.

Sue delivered new version of MOCEAN code to MODAPS.

Examined 129.1545 La865 with and without Lg removal.
Using tg=2,
the glint increase in La is essentially removed, with a
suggestion
of a La decrease close to the point of saturation. This trend is
also seen in the Lw fields for 551-678 where Lw increases
towards
the satureation point. Will try tg slightly smaller than 2. La
field now appears to be continuous through the glint field.
We also experimented with 1.9<tg<2.2. La865/765 suggests
that tg=2.1 is best.
Since the spectral trend in Lw suggests that correction is close
at 551 but
is undercorrected at 412 (overcorrected, too high lw at 6xx),
Jim removed
the diffuse correction at for spectral Lg (Lt-Lr). End result is
that
increased tg leads to smaller Lw for 4xx, 5xx. This results from
competition between spectral Lt-Lr vs La projected from 865.
Next
attempt is to restore diffuse (away from direct) and add La tau
to
the Lt-Lr to add radiance at short wavelength.

Warner reprocessed L1b for hawaii and eastcoast 129.
Examination showed
that we need to rebalance detector and mirror corrections. The
new MCST LUT reduces required corrections to order 1% or
less.

Ed's MATLAB analysis no longer can separate natural from detector
trends and remaining correction will be performed by image inspection.
Bands 15 and 16 corrected with most corrections order <0.5%, which was done
by Ed using the Hawaii 102 to select the Lt adjustments.

We processed 129.1545 using new pge02/lut and sun glint correction.
Two model shift problems remain causing discontiuities in Lw, but
the chlorophyll field was clean.  High signal in Lw678, 667 around
wcr north of stream with high Lw551.  CCR south of stream, east
and west of sun glint, shows high Lw551 in the ring's interior.
Sent Wayne copies of 129 chlorophyll and La with and without sun
glint correction.

Ed Kearns developed new flat fielding coefficients and these were
combined with the initialization band offsets.  A comparison run
using east coast 129 and Hawaii 102 showed that the glint correction
using tg=2.0 continues to work well for 412-551 and that 667 and
678 require some as yet uninvestigated changes.

The day 129 correction is generally the best yet obtained with La
essentialy decorrelated from Lw except for one area off the
continental boundary near Deleware where insufficient La is being
removed.  Day 102 at the calibration site shows increased excess
Lw with decreasing wavelength.  Both cases suggest a need for higher

model numbers/epsilon and an increase in the 7/8 separation. Previous work had a lowered 748 gain but the new LUT has changed
this; near Hawaii eps=1.22, model=13.

Structure in Lw fields for 129 is spectacular. La bands look continuous but
the epsilon and models fields show a offset for detector 1 with model number
one higher and epsilon increased relative to all other detectors. Suggested
chage is to decrease detector 1, band 15. Other needed chages is group
banding in 551 and 412 and 531 detectors 0 and 1. There is a vertical
discontinuity in all Lw bands at pixel 678.

Adjusted band 15 and 16 detector offsets in order 0.1% increments.
Detector 1 now easonably balanced, working on detector 10. Decreasing
band 16 factors relative to band 15 decreases epsilon and model number. Epsilon is more sensitive indicator of detector balance for bands 15/16. Adjusting band 15 gain factor to 1, equal to band
16 resulted in model selection that better corrects La front off eastcoast.

To raise Lw, we decreased the gain. We tried an increase in band
15 relative gain from 1.000 to 1.005 to check change in model selection off NJ coast. The model selection is 12 with surrounding
13 neighbors; 551 Lw too high in 12 area. Increasing the band 15
relative gain removed the excess radiance from all lw bands. Change
of 1% for detector 10 was too much, so we shifted back to 0.5%

The discontinuity at pix 677 is not present with the polarization correction
removed (aha!).

Sun glint calculation for MODIS (PGE09): Sun glint reflectance and
Rayleigh reflectance are removed from total reflectance before starting aerosol characterization.

Sun glint reflectance is computed as

glintref = glintsc * zglint * zbst(lambda) * t_star(lambda)

where

glintsc = 2.1 (sun gliter coefficient scale factor), range 1.4-2.0,
now set at 1.7
zglint = sun gliter coefficient using Cox and Munk (1954a,b; 1956)
[assumes isotropic wind]
zbst = two-way Rayleigh and Ozone diffuse transmittance
[sun--ground--satellite]
t_star = one-way aerosol diffuse transmittance using chosen model(s)
[ground--satellite]

The sun gliter calculation uses surface wind from six hour NCEP MET analysis.

Analysis shows strip patterns in Lw that result from model/epsilon
strips, principally from detector 10. There are areas in the image
where det 10 is high and others where 10 is low. There is a tendency for a local run of pixels in a given scan line to be different and thus decided to try a median rather than an average
for bands 15 and 16. Detector 10 La analysis suggests a 0.5%

decreas for band 15 Lt. The detector 10 problem appears to be linked to mirror side differences. The noisy La field challenge was initially minimized by computing a 3x3 average for the 7 and
8xx bands prior to initiating the atmospheric correction process. This approach worked well as long as no outliers were present, either due to 'clouds' or a detector problem. A second approach substituted a median filter for the mean. This approach was less
susceptible to sensor and data quality problems but produced a noisier image. A compromise approach is to median filter the 3x3
array, select the median and two neighboring pixels in radiance and average the selected 3 pixels. This produces the least noisy image. Further work is required for the detector 10 stripping.

The current coefficient correction table produces sufficiently clean images, neglecting detector 10, to enable use of the MOCE6
in situ data to compute the overall spectral gain corrections. Hawaii granules for days 101 through 107 will be used.

Bands 15 and 16 appear to be flat, at least at the precision we have. The offsets now appear to be confined to the individual bands for the hawaii image. However, the east coast image does
show stripping in the eps and model fields for some parts of the image. We started with 551 to arrive at corrections and asked Jim
to consider how to filter the model/eps fields. There also is a left side/right side dependence, probably associated with RVS. There is a det 1 to 10 trend on the right, at least in the eps field, past pix 1250 there appears a mirror side offset; all of these are associated with rvs or polarization.

We received notive from from Bruce G. that at launch instrument
settings before day 72 and after day 174 that require band 14h corrections for low number detectors. Between days are flat when

used with latest LUT.  Compare MCST and Miami corrections around
Sept 18.

Dennis mentioned that due to time offsets, expect several percent
differennce between MOS and MOBY readings.  Adjusted Lt gains for
Lw bands, reference is Hawaii day 102 with checks for other MOCE6
days.  Agreement close with exception of band 14 which remians
high.

Ed Kearns is examined L1B and Lw for further flat fielding adjustments.
We incrementally adjusted detector gains by band to improve flat
fielding.  Achieved nearly reasonable results but while stripping
was minimized, it remained apparent at high contrast and spatial
resolution.  Bands 15 and 16 have been re-examined and a residual
's' curve was found in both the bands where the 15/16 ratio is
reasonably smooth.  Band 15 and 16 Lt, without filtering, have been
processed to remove the trend while retaining a smooth 15/16 ratio.
The individual band trends are found to be a function of pixel
position leading to only a limited range of pixels, scan angles,
having optimal correction.

In addition, especially for band 8, a mirror side dependence on scan angle
has been observed.  The mirror side offset shifts from side 1 high to side 1
low progressing from left to right.  The La bands also show a mirror side
dependence at high AOI, right side of image.

A new option was added to MODCOL to deactivate band 15/16 averaging
to facilitate gain determination using La fields. Lt fields shows combination of Lr variations, glint and detector trends while the La field removes the geophysical trends. Detector changes should
be reduced by 0.5 to convert to equivalent Lt changes. 'useavg' option (default 1) to modcol to include averaging, useavg=0 to remove averaging.

Latest run shows little variation across bands 15 and 16 with small offsets
remaining in detectors 0 and 1.

other topics:

calibration/initialization:

setting overall band gains

748/865 relative gain - adjust 748 nm relative to 865 nm to produce 'proper' aerosol model. Proper means selecting
a model set that deconvolves La from Lw fields and fits expectations as to the type of aerosols that are likely present in a region.

blue, green, red bands - Use of in situ measurements, Clark MOCE6 ship and Hawaii optical buoy time series. Compare Satellite and in situ observations, adjust satellite
sensor gains to obtain agreement.

Lw to La bands. Use of Abbott fluorescence height and baseline calculation in regions without fluorescence. Adjust 7/8 relative to Lw bands to give equivalent height and baseline retrievals.

MODIS image observations:

Lw features observed in La bands.  (real optical signiture or instrument crosstalk?)

Features in green bands, utility of scattering to trace ocean circulation in low chlorophyll regions.

coherence of long, small scale features observable with the MODIS 1km spatial resolution.

Using day 129, we stepped band 15 gain from 0.95,0.98,0.99,1.00,1.05.
Chose 15/16 to remove atmosphere (currently selected 0.995), then used MOCE6 to set gains for bands 8-14 (gain seting referenced to hawaii day 102):

| band | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|
| 0.942 | 0.96 | 0.975 | 0.98 | 0.982 | 1.00 | 1.008 | new lut |
| 0,932 | 0.95 | 0.965 | 0.97 | 0.972 | 0.995 | 1.003 | e=0995-9/12 |
| 0.936 | 0.944 | 0.962 | 0.968 | 0.9705 | | 0.985 | 0.988 9/13 |

Without polarization, there was a trend along mid-image.  With polarization, the trend was removed but a 'jump' in Lw evident at
mid-image +/- 2 pixels.  This suggests problems with the phase function at the direct backscattering point. The trend suggests that
AOI is a function of both mirror scan angle and detector number.

The was also a gain shift along scan for detector 1, bands 15-16;
special filtering required,  currently causes image stripes.
RVS offset evident in 15/16 approximately starting at pixel 1300, while
RVS is evident for all of band 8.

Interesting to note was that water structure is seen in 748 and

865 bands, including Gulf Stream and further east.

Setting models, epsilon values: increments 748 vs 865 bands.
Selected correct value corresponding to eps/model that best
removes
La from Lw.  Selected band 7 gain correction 0.995.

We then restored polarization correction and 15/16 averaging.
Now
the detector to detector offsets <0.001, and began working with
MOCW6 data to set spectral gains.  If only MOS 102 is used,
412
and 443 Lw is too low (negative) in coastal areas.  Also low
relative
to other MOS days; these days occur at unfavorable scan
angles, at
edge, near clouds or glint field.

Previous gain setting approach used day 102, 9x9 average.
This
large average includes water structure in the buoy/ship area.
Following flat fielding, will now use 3x3 average.  Since day
102
retrievals (Lw) are high relative to other days, will now used
average of MOS stations.  Dennis agrees and observed that
wind
speeds tended to be high > 20knots and we should expect that
MODIS
will return higher radiances.

The remaining mirror side differences need  to be addressed,
412
for entire field, 7/8 and pixels>1300.  Gains need to be set at
the 0.0003 level to achieve detector to detector Lw and La
agreement
<0.001.

At present, gains and options produce very smooth fields but
detector 1 remains

a problem after including median filtering/averaging on band 15 and 16 for
epsilon calculation. Examination of bands 15 and 16 without filtering shows equivalent behaviour for all detectors; gaussian shape and negligible offset between detectors. However, the ratio
of 15 and 16 is well behaved for detectors 2-10, gaussian with negilgible offset while detector 1 shows a multi-mode, broad distribution suggesting noise affecting this channel but at varying
asynchronous times for the two detectors.

A new option has been added to MODCOL to bypass detector 1 for band 15 and
16 when computing epsilon.

Analysis of Hawaii granules shows inter-band gain problem with 15/16. In
areas of high epsilon, high model number insuficient radiance is removed
leaving high Lw whereas for low epsilon, low model number, too much La is
removed leaving low Lw. The low epsilon are too high, the high epsilon are
too low.

Open ocean, Hawaii granules, epsilon order 1.08 +/- 0.02 with model
selection around 8. Likely need to add bias to 15 and adjust gain to
increase model, epsilon spread. Also see enhanced scattering, 443 signal
around sea mounts NW of Hawaii.

We then noticed that we had a coding error for computing the 15/16 average radiances, this affected the La/eps/model calculations
in the data we used to flat field the detectors. Now the eps field and model selection are quite flat. There is a problem in the

bias/gain for 15 vs 16 yielding Lw lows to low and Lw highs too high. The eps need to be streched in range. We may need to have a bias and gain factor on 15 that either compresses or expands the 15 range?

Continued work on flat fielding. Detector 1 remains a problem and initial atempts to replace det 1 with 2 are only partially successful. Image stripping greatly reduced, although stripping still present in detector 1 slot; model and eps fields flat, eg, same values present for detectors 10,1,2. Stripping most prominent in long wave bands, magnitudes become smaller as wavelength gets shorter.

1)pixel-pixel continuity <1% of Lw (except det 1)

2)det 1 exhibits a AOI dependent gain. possibly the detector illumination changes as the mirror footprint increases with AOI. gain tends to decrease with AOI. also might include a 'noise' factor in that not all det 1 scans are affected.

3)band 8 mirror side offset is AOI dependent, across the entire scan.

4)bands 15/16 also exhibit AOI problems but only noticable for pixels > ~1275 - 1300. Likely present for other bands as well. The 15/16 problem is noticable in the 15/16 ratio used to calculate model/epsilon.

5)suggested band 15 gain not properly tracking band 16.

will likely need to determine both a bias and gain correction
for either 15 or 16. Problem indication is low epsilon/model
too high and high epsilon/model too low. End result is
high Lw too high and low Lw too low.

6)Have had to eliminate det 1 from atmospheric correction
calculation due to the AOI/noise problem. For all model,
epsilon calculations we use a median filter on a 3x3 box
surrounding the pixel of interest. The median filter is
used to reject 'bad pixels' defined as no in range Lt.
The the median pixel and two adjacent pixels selected by
data rank are averaged. The average 15/16 is used in the
model and epsilon calculation while the average 16 is used
for La calculation. Detector 1 is dropped for La calculations
for 15/16 is used in the model and epsilon calculation
while the average 16 is used for La calculation. Detector
1 is dropped for La calculations for detectors 10,1 and 2.

Detector 1 eventually might be useful if a switch to 'b' side electronics
minimizes the noise problem and we can determine a correction for the AOI
gain dependence.

We then ran global ocean color image for august 30, (243).
Several results:

* radiances tend to be higher on the sun (east) side of
the image, possibly wind direction dependent.

* a simple cloud test potentially is Nlw_678, initial
threshold is 2.55 watts, this value will remove some high
radiance coastal retrievals. A solution is to use the
'shallow water flag' and increase the threshold.

Jim  found an interplolation error in the phase function computation
that aided things somewhat.  Now the zipper has collasped to one
pixel.  Experimented with the tau-glint.  at 1.4 I get good chl,
at 2.0 I get good Lw.  Now running 1.6-1.7 as a seeming acceptable
compromise.

There remains a noticable assymetry between the left and right side
of the imagery/sun glint.  One the right sight the eps/Lw tends to
be flat.  On the left both are lower towards the sun glint and edge
of swath and higher towards the center of left hand side of the
image.  The higher Lw portion of the image is higher than any of
the other slices of sat zenith angle.  This trend appears to be
reasonably consistent across latitude and longitude.

We varied T-glint from 1.4 to 2.0, at 1.4 the chlorophyll is
continuous across the glint field while at 2.0 the Lw appears to
be more continuous.  Now using 1.x.

Implemented a 'cloud test' using Lt for 678nm.  Delta-Lt is approximately
delta-10*Lw.  Delta-Lw678 for the war come ring in image 129.1545 is order
<0.4w.  Test threshold is set to 6.0.

MOCE-MODIS comparison results:

Days are in order 101,102,103,104,107
MOBY
Var              Band:8  Band:9  Band:10 Band:11 Band:12 Band:13 Band:14
(diff)/MOBYLw:   0.4429  0.1362 -0.1259 -0.1647 -0.3834 0.0571 -0.5154

(diff)/MOBYLw:   0.2227  0.2228  0.1432  0.1997  0.2296
0.4500  0.3333
(diff)/MOBYLw:  -0.1230 -0.2716 -0.3827 -0.5591 -0.6764 -
8.6923 -9.3333

MOS
Var            Band:8  Band:9  Band:10 Band:11 Band:12
Band:13 Band:14
(diff)/MOSLw:    0.3218  0.1515 -0.0869  0.0091 -0.1887
3.9704  2.1729
(diff)/MOSLw:    0.0612  0.1033  0.0459  0.0710  0.0685
0.6059  0.7308
(diff)/MOSLw:   -0.2167 -0.3332 -0.3819 -0.4744 -0.6064 -
13.5156 -14.5318
(diff)/MOSLw:   -0.1327 -0.0869 -0.1362 -0.2473 -0.2773 -
8.5873 -0.7338
(diff)/MOSLw:   -0.0810 -0.0853 -0.0982  0.0074  0.0725
2.5837  3.1897

We tried new polarization tables (in $DSPROOT/cal) with
several
different schemes:

new_modis_pol_corr3.hdf  = normal
new_modis_pol_corr3b.hdf = all +pi/2
new_modis_pol_corr3c.hdf = 16 +pi/2
new_modis_pol_corr3d.hdf = 15 +pi/2
new_modis_pol_corr3e.hdf = 15,16 +pi/2

MODSST

Using a comparison of AVHRR Pathfinder sst (MPFSST),
MODIS SST and
SST4 shos that the at launch SST4 algorithm  shows a
pronounced
cooling with increased satellite zenith angle.  An alternative

algorithm that incorporates a secant term (constant*[sec(satz)-1]*[band20
- band23]) is better behaved at increasing satellite zenith angle.

MCST has provided corrections to the PGE02 code to correctly implement the
RVS tables for the emissive bands. This change improved RVS behaviour. The retrieved sst now exhibits noise at the 0.25C level.
Impact of switching to Terra/MODIS B-side electronics will be investigated once the instrument has been reconfigured.

Day 173-174 will be processed to assess algorithm and PGE02 changes
on SST and SST4.

Ed Kearns has validated the MODSST implementation by processing a
granule with the algorithm programmed in MATLAB and comparing with
the MODSST produced L2 granule.

Richard found clear east coast US images to compare 1km AVHRR images to
MODIS SST and SST4. Also comparee N14 and N15 (using N14 coefficients).
Ran sst, sst4 for days 242 and 243, compared with Pathfinder. SST4
was warmer than Pathfinder, 0-3C depending on water vapor load. SST
was colder by order 1C in Gulf of Aden.

The sst equations are now:

newSST4 [C] = a + b * BT + c * dBT + d * dBT * (sec(theta) - 1)

BT dBT const b(BT) c(dBT) d(sec)
B23 2322 0.547600 1.01113 -1.57292 -0.255732

"old" SST4 [C] = a + b * BT + c * dBT + d * dBT * (sec(theta) - 1)

| BT | dBT | const | b(BT) | c(dBT) | d(sec) | rms | refit |
|---|---|---|---|---|---|---|---|
| B20 | 2320 | 2.21785 | 1.04977 | 0.453908 | -0.622208 | 0.391 | 0.389 |

SST = c1 + c2 * T31 + c3 * T3132 * refsst + c4 * secterm

refsst = Reynolds SST reference field
secterm = (sec(theta) -1) * T3132

Coefficients c1, c2, c3 and c4 are respectively 1.11071, 0.9586865, 0.1741229 and 1.876752 if T3132 <=0.7 and are respectively 1.196099, 0.9888366, 0.1300626 and 1.627125 if T3132 > 0.7. (see table 3 of the ATBD).

To smooth the transition between the two sets of coefficients:

```
 if 0.5 < dCT <= 0.9 then
   use coefficient set 1 to compute SST1
   use coefficient set 2 to compute SST2
   w1 = (0.9 - dCT)/0.4
   w2 = 1 - w1
   SST = SST1 * w1 + SST2 * w2
```

### B.2 Matchup Database

Worked with Dennis Clark to assemble all MOBY and MOCE ocean color data that are coincident with MODIS granules. Jim is making modifications to the code to extract MODIS sst data for matchup points (MAERI, buoys).

## B.3 Systems Support

anc :

HDFroutines.c : Check for existance of input file before trying to open it.

atmcorshr :

colorin1.h colorin1.rat : Use full resolution (1km) geolocation data -- no more interpolation.

getcorrections.rat : Add real file name to messages, and fix string handling.

getcorrections.rat : Add slopes and intercepts for gross interdetector adjustments for : low and high AOI scan sides.

getcorrections.rat : Moved from modcol so modsst could use it also.

getcorrections.rat : Radiance corrections are now in one hdf file and chosen by the start time : of the granule.

hdf-wrd.c : Add REFreadC to read character SDS from hdf file.

hdf-wrd.c : Remove RefInit routine (no used for reading HDF files). : Increase maximum array dimensions to 6.

makefile : Add hdf_io_tools.c and hdf-wrd.c to atmcorshr so they can be used by : both modcol and modsst.

makefile : Add parsereals.rat to library.

binshr :

l3in.c : Add GranVer, L1b LUT version, to mod_get_l1b_attr_v2 output.

settbinmeta.rat : Make arrays longer to make sure they're big enough.

invgeo :

get_long_lat.c : Add logic to remember previously calculated values to speed up processing.

get_valid_scan_numbers.c : Check gflags to make sure corners are valid.

inv_geo_rouf.c : Make certain variables static to bypass one-time setup calcuations.

io :

caleval.c evlcal.c makefile : Fix mixed use of float and double; and use -O1 instead of -O2 to get : around compiler bug.

forge.c get.c : Correct problem with default values not set after initial command line parse.

get.c : Add Dsp_ParseCommandLine2 for incremental command line parsing.

get.c : Add new external routine to parse coefficients from a file given the : PGS toolkit lun and version. : Fix a mice parsing status re-initialization (do it only the first time).

get.c : Add parfile= mice table processing. Use PGS toolkit to access this file. : Use heuristic to add quotes to string input values.

get.c : Correct error message output.

get.c : Fix parse problem with Dsp_GetCommandLine2.

get.c : Look for semi-positional keywords.

get.c : Recognize '%%' (at the beginning of a line) as end-of-file in a parfile.

get.c : Use correct comment characters to disable two lines.

makefile : Allow semi-positional keyword decoding.

mfill :

makefile : Add NaN test function.

mfill.mice : Add/modify debugs. Fix use of l2 flags. Check for Nan's.

mfill.mice : Modify some if statements so that the compiler likes them. Declare tempo : as single instead of integer.

mice :

mice.c : Add subtext to error messages. : Disable one (unnecessary) ambiguous keyword test.

mice.c : Improve ambiguous argument checking. Make this a fatal error. : Merge differences between regular and MODIS mice utilities.

mice.c : Increase mice table size to 300 entries.

ml3b2mia :

l3in.c : Add GranVer, L1b LUT version, to mod_get_l1b_attr_v2 output.

mmap :

czcssubn.rat : Disable debugs.

makefile mmap.mice : Use parfile parsing for coeff and calibration input files.

modcol :

anly8com.rat : Add offset facter for writing i*2 instead of r*4.

anly8dbl.rat : Add F1 and F2 (optional) output files. : Fix error messages and set an error code for the *EQN, *SLOPE, *BIAS checks.

anly8dbl.rat : Add doavgch1 so detector 1 data can be replaced with detector 2 data (default). : Add line number to some macros (explicit instead of implied). : Correction to APPLY_RAD_FACTOR macro. : Disable debugging outputs.

anly8dbl.rat : Add missing array declarations. Add missing initializations.

anly8dbl.rat : Add option to output values as i*2, which needs new inputs for equations, : slopes, and intercepts to scale reals into i*2. Add latest radiance : corrections: interdetector adjustment and mirror side equalization. : Fix call to newatm: pass mirror side as an integer, not a byte.

anly8dbl.rat : Add variable ling to represent current line (detector) number : so it can be changed (such as when averaging).

anly8dbl.rat : Also compute averages for bands 13 and 14. : Outputs to files F1 and F2 are in reflectance.

anly8dbl.rat : Average 3 values centered on median for bands 15 and 16 if 5 or more : good values in 3x3 extraction else just use median value. : Correct declaration of working arrays to use MAX_INPUT_L2.

anly8dbl.rat : Check geolocation flags for every pixel. : Some granules have partial bad geolocation data for a frame. : Fix NDT table interpolation, divisor was off by 1.

anly8dbl.rat : Disable detector 1 for bands 15 and 16 (averaged values only). : Output averaged values in QC file for total_rads=2. : Add a few comments.

anly8dbl.rat : Display more digits for slopes and biases. : Correct BOUND_INT macro for invalid log values (compiler was too clever). : Add guard logic for F1 and F2 code: initialization and value setting.

anly8dbl.rat : Fix integer outputs for the 3 flour. products.

anly8dbl.rat : Implement integer output files (runtime option to choose integer or real). : Add aerosol correction failure code. : Print out new runtime variables. : Modify debugging printouts.

anly8dbl.rat : Use full resolution (1km) geolocation data -- no more interpolation. : Add 675 max-min cloud test (threshold value vs max-min in 3x3 box). : Add 765/865 choice for atmospheric correction. : Add whole scan line debug output.

anly8dbl.rat getcolpar.rat modcol.mice : Fix radiance corrections for High and Low AOI sides of scan by adding the : HighAOI parameter to specify which pixel to start the high corrections.

anly8dbl.rat hdf-io1.rat : Add Gross interdetector slope adjustment and channel 14 fudge factor. : Change checks for invalid values in Carder's products. For 'totalrads=1' : option, output La765 instead of pressure, and La865 instead of humidity.

anly8dbl.rat hdf-io1.rat : Initialize slopes and intercepts for real output values. : Fix checks for bad and saturated input values. : Fix scaling of Suspended Solids product. : Fix units for Suspended Solids.

anly8dbl.rat makefile wang3.f : modcol now averages bands 15 and 16, uses the averaged values to select : aerosol models, and uses the un-averaged values to correct the other bands.

anly8dbl.rat modcol.mice : Add new output file, F3, for testing new cocco and calcite algorithms. Add : use of granule start time and L1b LUT version to choose radiance corrections. : Parse keywords from radiance corrections to override params and pcf files.

anly8dbl.rat wang3.f : Add aerosol dust correction capability. : Add new coccolith algorithm and derive equivalent MODIS variables.

getcolpar.rat : Add doavgch1, default value is 2.

getcolpar.rat : Add f*eqn,f*slope,f*bias to coeff file.

getcolpar.rat : Add sun glint scaling coefficient.

getcolpar.rat : Allow total_rads to also be 2.

getcolpar.rat : Get more inputs from coeff file: totalrads, usereals, l2eqn, l2slope, l2bias, : l2aeqn, l2aslope, l2abias, l2beqn, l2bslope, l2bbias, qceqn, qcslope, qcbias.

hdf-io1.rat : Add granule start time and L1b LUT version for radiance corrections : selection.

hdf-io1.rat : Allow I*2 or R*4 output values. Change attribute describing scaling equation to : just the equation. Change the slope and intercept attribute names to match : the strings in the scaling equation.

hdf-io1.rat : Allow total_rads=2 (similar to total_rads=1).

hdf-io1.rat : Change units for suspended solids.

hdf-io1.rat : Correct input/output variables for AnlyOpO.

hdf-io1.rat : Fix calibration units and names for susp_solids_conc, cocco_conc_detach, : and calcite_conc.

hdf-io1.rat : Put units for susp_solids_conc back to g/m^3.

hdf-io1b.rat : Change band names for 'F' output files to numbers 1 to 12.

hdf-io3.c : Return granule start time and L1b LUT version for radiance corrections : selection.

hdf-io3.c modis_chl.1.c : Eliminate C compiler warning: fix prototype declaration.

hdf-wrd.c : Add REFreadI4 routine. : Should merge REFreadI4 into REFread (maybe next time).

ipar-1.2.f : Fix discrepancy between the units of input above-surface : downwelling irradiance supplied by Gordon's atmospheric code, : W/m^2/um, and the units that IPAR code expects, W/m^2/nm.

ipar-1.2.f : nm to um conversion factor must be divided and not multiplied.

makefile : Add hdf-io1b.rat to application.

makefile : Add new coccolith algorithm. : Move shared subroutines to common library.

makefile : Add new routines for parsing equations, slopes and intercepts from coeff file: : parsereals and parseeqn. Add -G4 for SGI to avoid a table overflow in wang3.f.

makefile : Increase fortran optimization size limit.

makefile : Move parsereals.rat to library.

makefile : Remove hdf-wrd.c and hdf_io_tools.c build lines.

modcol.mice : Add F1 and F2 (optional) output files.

modcol.mice : Add aerosol dust correction capability.

modcol.mice : Add doavgch1, make default value 2 (disable detector 1 data).

modcol.mice : Add sun glint scaling coefficient.

modcol.mice : Change LUNs for l2eqn useavg lacorband.

modcol.mice : Fix some band names in comments, mostly change 555 to 551.

modcol.mice : Make useavg default enabled(1).

modcol.mice : Update header documentation. Add usereals, and scaling stuff needed for I*2 : output values.

modcol.mice anly8dbl.rat : Add HRG debugging scan line output.

modcol.mice anly8dbl.rat getcolpar.rat : Add useavg switch to enable(1)/disable(0) use of averaged pixels.

modcol.mice getcolpar.rat : Add nlw_678_max and lacorband input parameters.

modcol.mice getcolpar.rat : Add parfile= support. Add verparm_XXX variables to mice table. : Rewrite getcolpar to only build the verparm array.

modis_chl.1.c : Correct setting of packaging flag bits.

modis_chl.1.c : Fix the NaN problem and make the big/small numbers more restrictive (exponent : of 10 instead of 38).

modis_chl.1.c : Increase APH_MIN to 0.0005 (smallest allowed aph675 value). : Use 1e+10/1e-10 as largest/smallest value limits (trap overflow/underflow). : Force default aph675 values smaller than APH_MIN to APH_MIN.

new_modis_pol_corr_sub.f : Fix documentation formatting.

rayleigh_rough.f : Fix documentation formatting.

rayleigh_rough.f : Rearrange IF statement to prevent improper memory access.

seabam_chlor.c : Add modis header.

setcolqual.rat : Fix typo in comment.

wang3.f : Add LTMLR variable (Lt-Lr-Lg).

wang3.f : Add debug statements.

wang3.f : Allow 765 or 865 to be used for atmospheric correction (removing La from Lt).

wang3.f : Fix error in array indexing after rearranging calculations.

wang3.f : More gracefully handle large solar zenith angle (just past boundary value).

wang3.f : Remove sun glint when removing Rayleigh (using aerosol from "previous" pixel). : Allow very few aerosol models (as little as 1 or 2).

wang3.f : Use correct array dimensions when declaring them.

modinc :

calibration.h : Add a float cast to RETURNFLOAT and ASSIGNFLOAT.

commoninout.h : Add comment to show that modcol is now using the common glint flag for : a cloud test.

commoninout.h commoninout.rat : Change comments and strings to use 551 instead of 555.

commoninout.h commoninout.rat : Fix units for cocco_conc_detach and calcite_conc.

commoninout.rat : Add comment to show that modcol is now using the common glint flag for : a cloud test.

commoninout.rat : Fix a comment.

commoninout.rat : Fix calibration units for U_Conc.

imgstdio.h : Fix typo in Dsp_ParseCommandLine, and add Dsp_ParseCommandLunVer.

newnames.h newnames.rat : Add Dsp_ParseCommandLunVer

ocean_lun.f ocean_lun.h ocean_lun.rat : Add two optional output files to modcol.

modisio :

mod_get_l1b_attr_v2.c modisio_v2.h : Add PGEver, the L1b PGE version, as an output parameter, and output : time strings using UTCB format instead of UTCA.

modis_smf.h : Fix spelling error.

modlib :

makefile : Add invgeo.

modsst :

get_emissivity.rat : Use $NAMSIZ instead of 128 for read buffer.

getsstpar.rat : Add parfile= support. Separate array for QC version data.

makefile : hdf-wrd and hdf_io_tools are in atmcorshr now.

makefile fakeetbp.rat etbpsub.rat etbpdef.rat etbpcom.rat : Implement correct sensor response tables (replaces simulated tables).

makefile modsst.mice : Move parsereals to atmcorshr so it can be used by both modcol and modsst. : Add some debugs. Fix loop index so slope and intercept attributes for Brights : are correct.

mcsstop.rat hdf-io.c : Get granule start time and L1b LUT version to pick a radiance corrections set.

modsst.mice : 'subsample' out the 8 pixels on either edge of the scan line. : Try two different versions of 20,23 sst4, one output in bright22.

modsst.mice : Add 'cldqual' option to use cloud bits from MOD35 file to determine quality. : Move command line regurgitation to get overrides from corrections file. : Use granule start time and L1b LUT version to choose a radiance corrections set. : Add/modify some debugs. Use keywords from corrections file to override : the pcf and params files. Fix index to outbffm array to initialize it : properly.

modsst.mice : Add parfile support. Add median averaging of 31 and 32 differences. Make : detector averaging optional. Add versions for brights and raws. Disable : processing of 8 pixels on edges. change alternate SST4 to use chan 22 instead : of 20 and hard coded coeffs.

modsst.mice : Change scaling info attribute strings for ease of use in IDL.

modsst.mice : Change some LUNs so that they are unique.

modsst.mice : Fix channel index into corrections arrays. Add/change some debugs. Don't : change bad geo flag to subsampled.

modsst.mice : Fix documentation in attributes. Add option to substitute detector 3 for 2. : Change option to substitute detector 2 for 1 for mirror side 2 only. : Use proper coeffs for sst4 20,22.

modsst.mice : Implement correct sensor response tables (replaces simulated tables). : Set correct scaling (slope, intercept) for raw bands in QC file. : Use log10(radiance) for bands 20,22,23 radiance -> temperature table.

modsst.mice : Remove debug.

modsst.mice : This time, put 'band2' where it really belongs.

modsst.mice : Update header and move 'band2' keyword back to where it was previously.

modsst.mice : Update header. Update use of routine that reads radiance corrections. : Use new SST4 algorithm (SST4_AFTER_000719). Fix use of LATZONE for previous : sst4 algorithm (even though it's not currently used). Fix debugs that : dump sst4 coeffs.

modsst.mice : Use 22,20; not 23,20 for SST4.

modsst.mice : Use center pixel instead of box average for sst.

modsstcoeffs.rat : Fix input of sst4 coeffs.

setsstqual.rat : Fix typo in comments. Make checks consistent and default to bad to make : sure qual is always set.

setuplog.rat : Echo more stuff from the mice table.

msbin :

binit.rat : Add logic to handle data starting to left of dateline and then extending : east across the dateline.

binit.rat : Allow for larger max values (1.e20 instead of 1.e16); fix side of : dateline determination.

binit.rat : Fix new restrict binning options.

binit.rat : Make sure navigation is valid before computing bin at this pixel. : Add debugging outputs for interpolation.

binit.rat : Use GEO_LON and GEO_LAT to make code more easily readable.

binit.rat msbin.mice : Add options to restrict binning of ocean color detector 1, ocean color pixels : not between a specified firstpix and lastpix, and/or sst pixels with uniformity : problems.

dayboundsub.rat : Add check for AM (Terra) vs PM (Aqua).

dayboundsub.rat : Split 'if' statements so array indices are checked before they are used.

hdf-iom.c : Add GranVer, L1b LUT version, to mod_get_l1b_attr_v2 output.

hdf-iom.c : Add check for AM (Terra) vs PM (Aqua) (prevous update includes some : of these changes also).

hdf-iom.c : Add white space.

hdf-iom.c : Fix size of Lookup array.

hdf-iom.c : Integer input values are unsigned.

msbin.mice : Add debugging outputs. Add a few comments.

msbin.mice : Add messages to know if terra or aqua/avhrr is being binned; add option to : not bin detector one in ocean color data.

msbin.mice makefile : Add parfile= support. Remove old routine getsbinpar.rat.

mspc :

makefile mspc.mice : Use IO library routines to parse parameter file. Move check for input : parameter to after input parsing.

mspc.mice : Only move 3 bytes of L2 flags into output array.

msstcloud :

mcloud.mice : Don't exit if the L2 flag names don't match.

mtbin :

makefile mtbin.mice : Add parfile= support. Remove gettbinpar.rat.

mtbin.mice : Check for both 'A' along with 'D' to decide on input pointer metadata. : Add check to make sure only MAX_INPUTPOINTER_FILES are put in the : input pointer array.

mtbin.mice : Check for invalid orbit numbers.

mtbin.mice : Don't exit if L2 flag names don't match.

mtbin.mice : Fix input pointer for 3-week files.

mtbin.mice : Fix setting of input files in metadata; and fix qapmd for files with no : flags (QC).

readaer-mod :

readem.f : Add new argument to REFInit call.

readdet-mod :

detread.f : Add new argument to REFInit call.

makefile : hdf_io_tools moved to atmcorshr readpol-mod :

polread.f : Add logic to filter/average input data. : Replace output fields with fixed values averaged over side and detector : (input values are too noisy and unreliable).

polread.f : Add new argument to REFInit call.

polread.f : Add test output files.

polread.f : Create variant data files (1b, 1c) with +/- pi/2 rotation.

reformat-mod :

hdf-wwt.c : Add INT32 routine.

hdf-wwt.c : Add REFWriteC. Add new argument to REFInit (parameter count).

makefile : hdf_io_tools moved to atmcorshr

wang3read.f : Add new argument to REFInit call.

reformat-ndt :

read.f : Add new argument to REFInit call.

## B.4 Team Interactions

Presentations:

1. Oceans from space -Venice
2. Ocean optics - Monaco
3. PORSEC – India
4. QAWG – boulder
5. MODIS Team Meeting

## C. Future Activities

### C.1 Processing Development

**Outstanding issues**

Mirror side ambiguity: Offsets are required to compensate for different reflectivity of the two scan mirror sides; at times mirror side identity is uncertain leading to scan striping. Principally affects 412nm, 443nm, and IR bands.

t sun glint scale factor (glintsc): Using a glintsc factor of 2.0 produced consistent behavior in Lw's fields, however, examination of global images showed asymmetric chlorophyll behavior from west to east along the scan line. Decreasing the glintsc factor to 1.4 produced consistent Chlorophyll behavior at the expense of the Lw retrievals. A glintsc factor of 1.65 was found to be an acceptable compromise to produce "reasonable" behavior in both Lw and chlorophyll fields. This glint correction is only approximate and needs further development.

Asymmetry in epsilon and Lw fields: Global fields show a persistent asymmetry from west to east. From the sun glint progressing to the eastern side of the image, epsilon and Lw's are uniform in regions of low geophysical variability. Immediately to the west of the sun glint and on the far western side of the image, epsilon and the Lw's tend to be lower; a parabolic shape in both epsilon and Lw retrievals is present as scan angle increases from the west toward the sun glint (figure 9 schematic). This suggests that the response of the 750 and 865nm bands is changing as a function of both satellite and solar zenith angle. The viewing geometry for MODIS is very different, this

RVS artifact maybe traceable to a bi-directional reflectance(BRDF) effect.

Location of MOCE station used for calibration: Only a single MOCE-6 station was suitable for use in calibration. This station was located west of the sun glint at a viewing geometry of high epsilon and Lw satellite retrievals (figure 9). Therefore, only the portion of the swath (~60%) with this viewing geometry will produce accurately calibrated Lw retrievals with pixel-to-pixel continuity of <1% .

**C.2 Matchup Database**

Code to extract MODIS pixels from multiple granules still under development.

**C.3 Systems Support**

Nothing notable.

**C.4 Team Interactions**

Weekly telecons with MCST, PIP and Oceans. Intermittent telecons with QA representatlive. Continued interactions with MODIS ocean PI's to coordinate algorithm and QA updates.